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INOCULATION AGAINST HYDROPHOBIA.*

By M. LOUIS PASTEUR.

THE prevention of rabies, as I have described it, in my own name and the names of my collaborators, in previous notes, certainly constitutes a real progress in the study of that malady, a progress which was, however, more scientific than practical. Its application was precarious. Of twenty dogs that I had then treated, I could not assert that I had made more than fifteen or sixteen proof against rabies.

It was expedient, on the other hand, to finish the treatment by a final exceedingly virulent inoculation, with virus of control, in order to confirm and strengthen the refractory state. Finally, prudence made it necessary to keep the dogs under observation for a longer time than the period of incubation of the disease produced by the direct inoculation of the last virus; and it thus required an interval not less, perhaps, than three or four months to be assured of a fully refractory condition. These necessities considerably limited the application of the method. The method, also, did not accommodate itself readily to contingencies, which were always immediate, growing out of the accidental and sudden character of the bites of rabid animals. It was therefore necessary to obtain, if possible, a more rapid method, and one more capable of giving a security which might be considered perfect over dogs. Besides, how, before reaching that stage of progress, could we venture to make an experiment on man?

After almost innumerable experiments I obtained a preventive method, practical and prompt, of which sufficiently numerous and assured successes have been gained upon dogs to give me confidence in its general applicability to all animals, and to man himself.

* A paper read in the French Academy of Sciences, October 26, 1885.

This method is based essentially upon the following facts:

Inoculation of a rabbit, by trepanning, under the *dura mater*, with the poisonous marrow of a mad dog, always gives rabies to the animal after a mean period of incubation of about fifteen days. If the virus is passed from this first rabbit to a second, from this one to a third, and so on, by the same method of inoculation, there is shortly manifested a more and more marked tendency toward a shortening of the period of incubation in the rabbits successively inoculated. After from twenty to twenty-five passages from rabbit to rabbit, we arrive at a period of incubation of eight days, which is maintained during a new series of from twenty to twenty-five passages. Then we have a period of incubation of seven days, which occurs with striking regularity during a new series of passages rising to the ninetieth. At least that is the number I have now reached without having hardly yet observed a tendency to a slight further shortening of the period.

The experiments of this character, which I began in November, 1882, have already been continued for three years without the series having been interrupted, or without my having used any other virus than that from rabbits which successively died rabid. Nothing, therefore, is more easy than to have at one's disposition, during considerable intervals of time, a virus of perfect purity, always identical, or nearly so. This is the practical point of the method.

The marrows of these rabbits are infected with rabies of constant virulence in their whole extent. If we detach from them pieces a few centimetres long, taking the greatest possible precautions to insure their purity, and suspend them in dry air, the virulence of the rabies in them will slowly pass away, till it is quite extinguished. The duration of the process varies somewhat with the thickness of the marrow, but depends chiefly on the exterior temperature: the lower the temperature the longer the virulence lasts. These results constitute the scientific point of the method.*

These facts being substantiated, we have the following method of making a dog, within a reasonably short time, proof against rabies.

In a series of flasks, the air of which is kept dry by pieces of potash in the bottom, we suspend each day a piece of freshly infected marrow from a rabbit that has died of rabies, developed after seven days of incubation. Every day, at the same time, we inoculate under the skin of a dog a Pravaz syringeful of sterilized broth, in which has been soaked a small piece of one of the marrows we are keeping in desiccation, beginning with one of those which we have prepared several days before our operation is performed, so as to be sure that it is not of full strength. On that subject we have informed ourselves by previous experiments. We operate in the same manner on the following days

* If the infected marrow is protected from the air, and is kept moist in carbonic acid, the virulence will last, for several months at least, without change in intensity, provided it be guarded against the attack of microbes from without.

with more recent marrows, separated from one another by, say, two days of age, till we come at last to a very recent one, which has been in the flask for only one or two days. The dog is then found to be made proof against rabies. We can inoculate him under the skin, or even, by trepanning, under the surface of the brain, without the disease showing itself.

By the application of this method I had succeeded in getting fifty dogs, of various ages and races, proof against rabies without having had a single failure, when, on the 6th of July last, three persons from Alsace unexpectedly presented themselves at my laboratory: Theodore Vone, a grocer of Meissengott, near Schelstadt, who had been bitten in the arm on the 4th of July by his own dog, become mad; Joseph Meister, nine years of age, who had been bitten by the same dog at eight o'clock in the morning of the same day, and who, thrown to the ground by the dog, bore the marks of numerous bites on his hand, legs, and thighs, some of them so deep as to make walking hard for him. The more serious wounds had been cauterized only twelve hours after the accident, or at eight o'clock in the evening of the same day, with phenic acid, by Dr. Weber, of Villé; the third person, who had not been bitten, was the mother of Joseph Meister.

At the autopsy of the dog, which had been killed by its master, we found its stomach filled with hay, straw, and pieces of wood. It was certainly mad. Joseph Meister had been picked up from under it covered with froth and blood. M. Vone had marked bruises on his arms, but he assured me that the dog's teeth had not gone through his shirt. As he had nothing to fear, I told him he might go back to Alsace the same day, and he did so; but I kept little Meister and his mother.

The weekly meeting of the Academy of Sciences took place on the 6th of July. I saw our associate, Dr. Vulpian, there, and told him what had passed. He and Dr. Grancher, professor in the École de Médecine, had the kindness to come and see little Joseph Meister at once, and ascertain his condition and the number of his wounds, of which there were no less than fourteen. The opinion of these two physicians was that, in consequence of the severity and number of the bites upon him, Joseph Meister was almost certain to have hydrophobia. I then informed them of the new results which I had obtained in the study of rabies since the address I had delivered at Copenhagen a year previously. The death of this child seeming inevitable, I decided, not without considerable and deep anxiety, as you may imagine, to try upon him the method with which I had had constant success on dogs.

It is true that my fifty dogs had not been bitten before I found them to have been made proof against rabies. But I felt that I might dismiss all anxiety on this point, because I had already obtained a similar condition on a large number of dogs after they had been bitten.

Thus, on the 6th of July, at eight o'clock in the evening, sixty hours after he had been bitten on the 4th, in the presence of Drs. Vulpian and Grancher, we inoculated under a crease made in the skin of the hypochondrium of little Meister a half-syringe Pravaz of marrow of a rabbit that had died of rabies on the 21st of June, which had been kept since that time, or for fifteen days, in a flask of dry air.

New inoculations were made, always in the hypochrondres, under conditions of which a table is here given :

A HALF-SYRINGE PRAVAZ.

July	7,	9 A. M.,	marrow of	June	23,	14	days old.
"	7,	6 P. M.,	"	"	25,	12	"
"	8,	9 A. M.,	"	"	27,	11	"
"	8,	6 P. M.,	"	"	29,	9	"
"	9,	11 A. M.,	"	July	1,	8	"
"	10,	11 A. M.,	"	"	3,	7	"
"	11,	11 A. M.,	"	"	5,	6	"
"	12,	11 A. M.,	"	"	7,	5	"
"	13,	11 A. M.,	"	"	9,	4	"
"	14,	11 A. M.,	"	"	11,	3	"
"	15,	11 A. M.,	"	"	13,	2	"
"	16,	11 A. M.,	"	"	15,	1	day old.

I thus made the number of inoculations thirteen, and the number of days of treatment ten. I would say, furthermore, that a smaller number of inoculations would have been sufficient. But it is easily conceivable that in this first trial I should have acted with particular caution.

We also inoculated, by trepanning, two new rabbits with each of the several marrows employed, in order to test their states of virulence. The observations on these rabbits permit me to assert that the marrows used on the 6th, 7th, 8th, 9th, and 10th of July were not virulent, for they did not make the rabbits mad. Those of the 11th, 12th, 14th, 15th, and 16th of July were all virulent, in proportion as the marrow was fresher. Rabies declared itself after seven days of incubation in the rabbits of the 15th and 16th of July ; after eight days in those of the 12th and 14th ; and after fifteen days in those of the 11th of July.

I had thus in the last days inoculated Joseph Meister with the most virulent virus, that of the dog strengthened by several passages from rabbits to rabbits ; it was a virus that gave rabies after seven days of incubation to these animals, after eight or ten days to dogs. I was justified in venturing on this experiment by what had taken place with the fifty dogs of which I have spoken. When the state of immunity is reached, we can, without inconvenience, inoculate with the most virulent virus, and in any quantity ; and it has seemed to me that this had no other effect than further to confirm the condition of refractoriness against rabies.

Joseph Meister, then, has escaped, not only the rabies which his bites would have developed, but also that with which I inoculated him in order to confirm the immunity secured by the treatment—a more virulent rabies than that of the mad dog. The final extremely virulent inoculation had also the advantage of putting a term to the duration of the apprehensions we might entertain as to the consequences of the bites. If rabies was to break out, it would declare itself more speedily with a more virulent virus than that of the bites. From the middle of August I regarded the future of the health of Joseph Meister with confidence; and now, after three months and three weeks have passed since the accident, his health leaves nothing to be desired.

What interpretation shall we give to the new method which I have just described for preventing rabies after being bitten? I do not intend to consider this question in full to-day; but will limit myself to a few preliminary details, such as may help to comprehend the significance of the experiments which I prosecuted for the purpose of directing attention to the best of the possible interpretations.

Recurring to the methods of progressive attenuation of mortal viruses, and the prophylaxy that may be deduced from it, and the influence of the air in the attenuation being given on the other side, the first thought that occurs in trying to account for the effects is that the continued presence of rabies-infected marrows in contact with dry air progressively diminishes the intensity of their virulence till it is rendered *nil*. We are, therefore, led to believe that the prophylactic method under consideration rests upon the employment at first of virus without appreciable activity; then of weak viruses, and then of those of greater and greater virulence. I shall show, further on, that the facts are in disaccord with this view. I shall prove that the increase in the length of the periods of incubation of the rabies, communicated day after day to rabbits, as I have just said, to test the condition of virulence of our marrows, dried in contact with the air, is an effect of impoverishment in the quantity of the virus contained in the marrows, and not an effect of its impoverishment in virulence.

We may suppose that inoculation with a virus of virulence constantly identical in itself may lead to a condition proof against rabies by the process of employing very small but daily increasing quantities. This interpretation of the facts of the new method I have studied experimentally. . . .

I need not remark, in conclusion, that the most serious of the questions to be resolved now is perhaps that of the interval that should be observed between the time when the patient is bitten and that at which the treatment should be begun. In the case of Joseph Meister, the interval was two days and a half. But there is reason to suppose that it may sometimes be much longer.

On Tuesday last, the 20th of October, with the obliging assistance of Drs. Vulpian and Grancher, I began to treat a young man fifteen years old, who had been bitten six days before, in both hands, and whose condition was exceptionally grave.

The Academy will perhaps not be uninterested to hear the story of this young man's courage and presence of mind. He is a shepherd, named Jean-Baptiste Jupille, of Villers Farlay in the Jura, who, seeing a large dog of suspicious appearance rush at a group of six of his comrades, all younger than himself, sprang, whip in hand, in front of the animal. The dog seized Jupille by the left hand. Jupille then knocked the dog down, held it under himself, opened its jaw with his right hand to relieve his left, not without receiving several new bites, and then, with the thong of his whip tied up its muzzle, and, taking off one of his wooden shoes, dispatched the dog with it.

I shall promptly make known to the Academy the outcome of this new experiment.

[After the reading of M. Pasteur's paper, M. Vulpian remarked that the Academy should not be surprised to see one of the members of the Section of Medicine and Surgery take the floor to express the feelings of admiration which the communication had inspired in him. These feelings, he continued, "will be shared, I am convinced, by the whole medical profession. A remedy has at last been found for rabies, that terrible malady, against which all therapeutic measures had miscarried till now. M. Pasteur, who has had no precursor in this road, has been led, by a series of researches pursued uninterruptedly for years, to create a method of treatment that enables him surely to prevent the development of hydrophobia in a man who has been bitten by a mad dog: I say surely, because, after what I have seen in M. Pasteur's laboratory, I do not doubt the constant success of this treatment whenever it is put in practice in its completeness within a few days after the rabid bite has been inflicted. It becomes henceforth necessary to take into consideration the organization of a service for the treatment of hydrophobia by M. Pasteur's method. Every person bitten by a mad dog must be made able to enjoy the benefit of this great discovery, which affixes the seal to the glory of our illustrious associate, and which will shed an incomparable luster upon our dear country." On motion of Baron Larrey, a prize was proposed for young Jupille, in recognition of his bravery and devotion.

The President of the Academy, M. Bouley, expressed his full sympathy with the feelings which the Academy had just manifested by its applause. The date of the 26th of October, 1885, he said, would be marked as a great day among the festivals of French biology and medicine, and among the festivals of the medicine of the whole world. He would ask M. Pasteur whether, if, during the course of the preventive inoculations, an inoculated dog should bite a person or other animals in play, it would communicate rabies to them.

M. Pasteur replied that no experiments bearing on that point had yet been made.

On the 30th of October four other persons came from Arcachon to place themselves under M. Pasteur's care; so that, if success is gained in these cases also, six demonstrations will have been obtained from human subjects of the efficacy of the inoculation treatment. In an interview with a correspondent of the London "Times," M. Pasteur explained the philosophy of his treatment by stating that the virus acted very slowly, and, while he was making the body refractory to it by repeated inoculations, the virus deposited by the bite localized itself in the region of the wound. Whatever this region, that virus becomes digested during the year and a half which he has found by experiment the inoculation lasts, and will no longer exist in the body. As the propagation of the virus, which has always an ascending tendency and directs itself to the brain, takes place so slowly that the minimum of the total inoculation with it is thirty days, the whole question consists in inoculating the patient soon enough to prevent the propagation of the virus through the wound from spreading. In the case of Jupille, after the lapse of six days, the virus through the wounds had not yet left the hands. Consequently, it had not yet penetrated into any of the regions where its presence causes an outbreak of rabies. It will remain cooped up, till after some months it will have been digested and expelled.

There would be no need to dwell on the value of M. Pasteur's discovery, the "Times" suggestively remarks, "were it not for the strange perversity of those who will only see in the whole story a fresh ground for attacking physiological experiment. Such people, as we know from long experience, will lose all sight of the thousands and tens of thousands of animals whom M. Pasteur liberates from the curse, and of the multitudes of human beings freed from torture and death, when they think of the twenty or fifty rabbits in his laboratory. They forget, in the contemplation of a few cases of immediate suffering, the innumerable animals, friends of man, whom the discovery will set free. With these excellent people it is impossible to argue; but men whose sympathies are wider and whose sight is truer than theirs will unite in paying homage to the man who, if what he tells us is confirmed, has worked so patiently and so wisely to so noble and beneficent an end."
—EDITOR of "The Popular Science Monthly."]

THE ORIGIN OF PRIMITIVE MONEY.

By HORATIO HALE.

THE European colonists who first became acquainted with the Indian tribes of the region now composing the United States and Canada were surprised and not a little interested when they found that these barbarous clans had, in one respect, a marked advantage over the great semi-civilized communities of Central and South America. The Mexicans and Peruvians were much addicted to traffic; but, like the Egyptians and Assyrians of early ages, they carried on their commerce without the use of money. The wampum of the Northern tribes was a real money, and as such it was destined to play an important part, for more than two centuries, in the intercourse between them and their white neighbors. Lawson, the historian of Carolina, writing nearly two hundred years ago, described in quaint but expressive terms, and with a satiric touch aimed at his own people, the place which this remarkable invention held in the social policy of the red-men. "This," he says, "is the money with which you may buy skins, furs, slaves, or anything the Indians have; it being the Mammon (as our money is to us) that entices and persuades them to do anything, and part with everything they possess, except," he adds significantly, "their children for slaves. . . . With this they buy off murders; and whatsoever a man may do that is ill, their wampum will quit him of, and make him, in their opinion, good and virtuous, though never so black before."

So common and wide-spread was the use of this money among the Indians, that the white colonists were fain to adopt it from them, and their laws for a time gave it an established value and circulation throughout New England and New York. In Massachusetts, as Dr. Ashbel Woodward tells us in his valuable monograph on "Wampum," it was made by statute, as early as 1637, a legal tender for any sum under twelvepence, at the rate of six beads for a penny; and in Connecticut it actually became a legal tender for any amount, being receivable for taxes at four beads for a penny. In Massachusetts the same valuation was adopted in 1640, four white beads or two blue beads being rated at a penny. In New York, for nearly half a century, owing to the scarcity of silver money, wampum was almost the only currency in use; and, though its circulation in ordinary traffic gradually ceased, it was still employed in the Indian trade down nearly to the middle of the present century.

The material of this aboriginal currency may be described briefly as "shell-beads." It must not, however, be confounded with the cowries, or small shells, which are in use for a similar purpose in some

parts of India and of Africa. It differed from them, in fact, as coined money differs from bullion. Wampum was a manufactured article. The great labor required to produce it was, indeed, the main element in its value. It was used in two forms. The least common, but apparently the earliest form, was that of disks, varying in size from that of an English sixpence, or rather, perhaps, from that of an American half-dime, to that of an English shilling, but somewhat thicker than these coins. One writer compares them, for size and thickness, to a peppermint-lozenge. These disks were perforated through the center, and commonly threaded upon a string. The other and more usual kind was of cylindrical shape, resembling the segment of a clay pipe-stem. These smaller beads had a diameter of about the eighth of an inch, and a length about twice or three times as great. Like the others, they were perforated, and usually strung upon a deer's sinew or a string of some description.

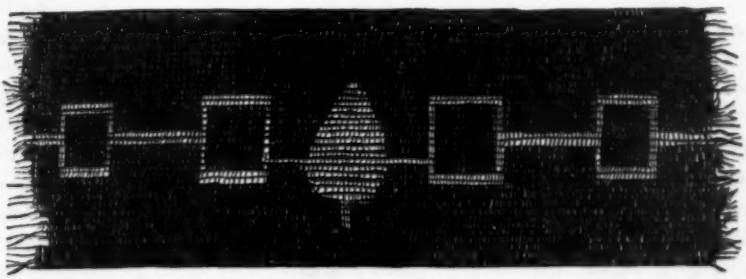
These disks, or cylinders, were of two colors, white and dark-purple, the latter generally styled black. They were made from sea-shells of several descriptions. The white beads were usually derived from various species of periwinkles or conchs. The purple sort were made chiefly from the large round clam, common on the Atlantic coast, and known by the Indian name of *quahaug*, and in science as *Venus mercenaria*. This mollusk has near the anterior end of the otherwise white inside of each valve a deep purple or brownish-black scar, indicating the point of muscular attachment, and known to fishermen as the "eye." This dark spot was broken out by the Indians to form their "black wampum," which, from its greater rarity, was always rated at a higher value than the white beads. Such, in brief, is the account given by Mr. Ernest Ingersoll, in his excellent article on "Wampum and its History," in the "American Naturalist" for May, 1883. The Indians who lived along the sea-coast were the principal manufacturers, and drove a brisk trade in this article with the tribes of the interior. Long Island, in particular, was a noted seat of this industry. It was the Potosi or California of the Northern Indians, and bore among them the name of Seawanhake, or "Land of Wampum." In traffic the money was computed sometimes by the number of beads, and sometimes by the length of the string.

The word *wampum* is of Algonkin origin. Its application to this money originated in a misconception of the early colonists. Properly it means simply "white." *Peage* or *peake*, we are told, was the name of the shell-beads, at least when strung. When loose, the term *sewan* (or, as pronounced by the Dutch colonists, *zeewand*) was applied to them. This term is said to mean simply "scattered," or "loose." A string of white beads, the most common currency, was called by the Indians *wampum-peak*, or "white strung-beads." The first portion of the compound word was caught by the settlers, and hence all money-beads became known among them as "wampum."

To break from the shell the fragment suitable for a bead, to rasp it on a stone to the proper circular or cylindrical shape, to polish it to an ivory smoothness, and then to pierce it with a drill-point of flint, was a tedious labor. It was this labor which, in great part, gave the wampum its value. This alone, however, would not have been sufficient, if the article had not held, in the social system of the Indians, a position which kept it always in demand. By their custom, handed down from time immemorial, it was essential that all great acts of state policy should be accompanied by the exhibition of wampum in some form. The messenger who summoned the chiefs of a tribe to a public meeting bore a string of wampum to authenticate his errand. The embassador, in proposing a treaty, laid down a string or belt of wampum at the close of every clause of his address. When the treaty was concluded, several belts were usually exchanged, by way of ratification. A belt of black wampum, formally delivered, was a declaration of war. A string of black wampum, borne by a runner, announced to all the villages of an Indian nation the death of a high chief; and, at his burial, belts and strings of wampum were deposited in his grave. At the great religious festival of the Iroquois, the "Sacrifice of the White Dog," the dead animal was enveloped in strings of wampum, which were burned with him. The belts and strings which accompanied the making of treaties and the framing of laws were kept as tribal records, and were brought forth on great occasions to be exhibited and explained to the people. The belts which commemorated the conclusion of the famous League of the Iroquois, framed by Hiawatha, Atotarho, and their associate chiefs, four hundred years ago, are still preserved on the Onondaga Reservation in the State of New York.

The belts, it should be added, were composed of short strings of wampum, containing from six to twenty-four beads each, laid side by side, and closely knotted together. The length of the string made the width of the belt, which varied from two to nine or ten inches, while its length varied from two to eight feet. The wider and longer the belt, the greater, of course, was its value, and the higher its significance as a pledge or memorial. Each belt usually had its special device, whose meaning was well understood. This device was wrought sometimes in white beads on a dark ground, sometimes in purple beads on a white ground. These symbols were genuine hieroglyphics, resembling the ancient pictorial figures in which the modern Chinese characters had their origin. In the Chinese script a parallelogram signifies an inclosure; it is the fence of a field. On an Iroquois belt a parallelogram denotes a town; for with them, in ancient times, the town was inclosed in a rectangular palisade. A lozenge-shaped figure represents a council; it is the Indian hearth, around which the councilors assembled. Oblique marks across a belt are the stamp and token of the Iroquois confederacy. They represent the rafters of the "long-house," to which the confederacy was likened. Others of these sym-

bols are remembered, but a far greater number have been forgotten. Of the many hundreds, and indeed thousands, of belts which are known to have been fashioned during the last three centuries, each bearing its own device, less than fifty whose meaning can be explained are now known to exist.



Wampum Belt, commemorating the formation of the League of the "Five Nations" (Iroquois). The lozenge-shaped figure represents a native hearth, and indicates the Onondagas, the central nation who kept the council-fire of the confederacy. The square inclosures represent the other nations, the Mohawks and Oneidas on the right (or east), and the Cayugas and Senecas on the left. The connecting lines denote the "peace-path" opened between the nations by the League. The belt is about two feet long and ten inches wide.

Shell-beads exactly resembling the wampum are found in great abundance in the graves of the mound-builders, and sometimes, along with them, the large conch-shells from which such beads were made. Messrs. Squier and Davis, in their well-known work on the "Ancient Monuments of the Mississippi Valley," remark that "the number of beads found in the mounds is truly surprising; they may be counted in some instances by hundreds and thousands." They are described as resembling "sections cut from the ends of rods, or small cylinders, and subsequently more or less rounded upon the edge. Some are quite flat, and resemble the bone buttons of commerce; others are perfectly round. Their diameter varies from one fourth to three fourths of an inch. The size of the perforation is also variable, usually, however, about one tenth of an inch." No one doubts that these beads were used for the same purposes among this vanished people as among their successors. Dr. Daniel Wilson, in his admirable work on "Prehistoric Man," after referring to the fact that in the great Grave Creek Mound, evidently reared over the tomb of some notable personage, the shell-beads, such as constitute the wampum of the forest tribes, amounted to between three and four thousand, finds it "singularly consistent with the partial civilization of the ancient mound-builders that in such deposits we have the relics of sepulchral records, which constituted the scroll of fame of the illustrious dead, or copies of the national archives deposited with the great sachem, to whose wisdom or prowess the safety of his people had been due."

Indeed, when we consider that the tribes among whom the wampum currency and records were afterward used, in the particular form thus far described, were those which at first surrounded and after-

ward either conquered or absorbed this semi-civilized people, we might be tempted to conclude that the knowledge of this peculiar invention was a bequest to these modern tribes from their more advanced predecessors — just as some of the arts of Roman civilization were inherited by the barbarous conquerors of the empire. It is not impossible, nor indeed very improbable, that such may have been actually the case in this instance. But further inquiry shows that this system had a wider extent and probably a far remoter origin than this suggestion would explain.*

Crossing the Rocky Mountains, we find the shell-money in actual use among the tribes of the Pacific coast, down almost to our own day. Three kinds were known. In Northern California, in Oregon, and still farther north, a rare species of cylindrical univalve, the *Dentalium*, or tusk-shell, known in the Chinook "jargon" as the *hiqua*, or *ioqua*, was strung upon a string, and used as money. Its extreme rarity and its attractiveness as an ornament made, as with the pearl, its only claim to value. But farther south the genuine wampum, or disk-money, owing its value to the labor bestowed upon it, and to its importance in the social policy of the people, was in universal use. Full and interesting details on this subject are given by Mr. Stephen Powers in his instructive work on the "Tribes of California." Among the Nishinams and, as he believes, among all the tribes of Central and Southern California, the materials chiefly used are two species of sea-shell, found upon the coast. The most common is a thick white shell, the *Pachydesma crassatelloides*, from which is formed the money known as *hâwok*. This consists, he writes, "of circular disks or buttons, ranging from a quarter-inch to an inch in diameter, and varying in thickness with the shell. These are pierced in the center, and strung on strings made of the inner bark of the wild cotton, or milkweed (*Asclepias*), and either all the pieces on a string, or all in one section of it, are of the same size." The value of this money varies with the size of the disks. The larger pieces are rated at about twenty-five cents; the half-inch pieces at about half that value; and the smallest pieces at three or four cents, being usually rated by the string. "This," continues Mr. Powers, "may be called their silver, and is the great medium of all transactions; while the money answering to gold is made from varieties of the ear-shell (*Haliotis*) and is called *ullo*. They cut these shells with flints into oblong strips, from an inch to two inches in length, according to the curvature of the shell, and about a third as broad as they are long. Two holes are drilled near the narrow end of each piece, and they are thereby fastened to a string of the material above-named, hanging edge to edge. Ten pieces generally constitute a string, and the larger

* Those who desire to pursue this inquiry will find ample material in the valuable essay on "Art in Shell of the Ancient Americans," by Mr. W. H. Holmes, in the Second Annual Report of the Bureau of Ethnology.

pieces rate at one dollar apiece—ten dollars a string; the smaller in proportion, or less, if they are not pretty. Being susceptible of a high polish, this money forms a beautiful ornament, and is worn for necklaces on gala-days. But as money it is rather too large and cumbersome, and the Indians generally seek to exchange it for the less brilliant and more useful *hâwok*. The *ullo* may be considered rather as jewelry. The peculiar shape given to this *ullo*, or "gold-money," is deserving of notice, as will be seen hereafter.

Of the shell-money in general Mr. Powers remarks that "immense quantities of it were formerly in circulation among the Californian Indians, and the manufacture of it was large and constant, to replace the continual wastage which was caused by the sacrifice of so much upon the death of wealthy men, and by the propitiatory sacrifices performed by many tribes, especially those of the Coast Range." This use of shell-money in sacrifices and in funeral ceremonies is precisely the same that is made of the Eastern wampum. Like the shape of the oblong *ullo* money, this is a fact which will be found significant as we proceed. Mr. Powers continues: "From my own observations, which have not been limited, and from the statements of pioneers and the Indians themselves, I hesitate little to express the belief that every Indian in the State, in early days, possessed an average of at least one hundred dollars' worth of shell-money. This," adds the author, with a commercial precision which is both commendable and amusing, "would represent the value of about two women (though the Nishinams never actually bought their wives), or two grizzly-bear skins, or twenty-five cinnamon-bear skins, or about three average ponies. This may be considered a fair statement of the diffusion of wealth among them in their primitive condition."

Thus it will be seen that shell-money of this peculiar character was in use over a wide space of North America, stretching from the Atlantic coast to the Pacific. The line along which it is found in the greatest abundance extends from New York and the Ohio Valley to Southern California in a direction somewhat south of west. If we continue this line in the same direction a little more than half-way across the Pacific, we arrive at the widely extended range of small islands, or congeries of island-groups, known in modern geography by the name of Micronesia. It fills a great part of the western half of the ocean north of the equator, and comprises the Radack and Ralick chains, the Kingsmill and Marshall groups, the Marian (or Ladrone) and Caroline Islands, the Pelews, Panape, Eap, and many smaller clusters and single islets. The well-known Loo-Choo islands form the stepping-stones, as it were, which lead from this vast archipelago to China and Japan. The natives of Micronesia are in about the same social stage as that which had been attained by the North American Indians when they were first known to the whites. In character, usages, and language they resemble to a certain extent the natives of the southern and east-

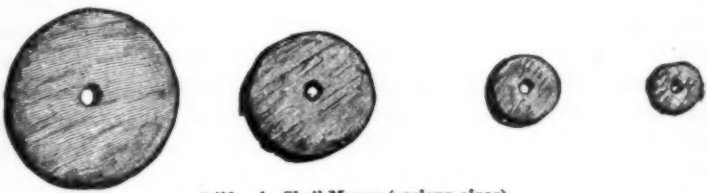
ern Pacific groups, which are included in the designation of Polynesia, but with some striking differences, which careful observers have ascribed, with great probability, to influences from Northeastern Asia. They are noted for their skill in navigation. They have well-rigged vessels exceeding sixty feet in length. They sail by the stars, and are accustomed to undertake long voyages.

The southernmost group of Micronesia, commonly known as the Kingsmill Islands, was visited and partly surveyed by the vessels of the Wilkes Exploring Expedition. During a very brief intercourse with the natives of the principal island, Taputeuea, large quantities of what was at first supposed to be an ornament were obtained from the natives, in exchange for other wares which they valued. This peculiar article was thus described, before its real character was understood: "It consists of a string of alternate wooden and shell beads, if this term may be applied to them. The 'beads' are in the shape of a sixpence with a hole through its center, or more nearly like the 'button-molds' of our dress-makers. They are made of fragments of cocoanut-shell and sea-shells, which are broken or cut nearly to the required shape, and then filed down together till they are smooth, even, and exactly of equal size. Those of sea-shell are white, and those of cocoanut black. They are strung alternately upon a small cord, and appear like a round flexible stick, half an inch in diameter, marked with alternate white and black rings." The beads, it appears, by the specimens preserved in the National Museum at Washington, were not all of one size. Besides the larger sort, resembling an English sixpence, there was a smaller description, of about half that size, and bearing when strung a surprising resemblance to a string of small wampum-beads, the only difference being that the Kingsmill Island disks are thinner than the proper wampum cylinders; but both in size and in thickness they resemble closely the smaller shell-money of California.

Further researches disclosed the true nature of this article, which, as it appeared, had been already studied and described by earlier voyagers at other islands of the Micronesian range. Adalbert von Chamisso, the naturalist who accompanied Admiral Kotzebue in his voyage around the world, was the first to make known its character and use. In speaking of the natives of the Ladrone Islands, now an extinct people, he remarks: "We have discovered among their antiquities something which seems to show a great advance made in civilization beyond any of the other islanders of the great ocean. We speak of the invention of money. . . . Disks of tortoise-shell, of the shape of button-molds, but thin as paper, and made extremely smooth by rubbing, are strung close together on a thick cord of twisted cocoanut-husk. The whole forms a flexible cylinder of the thickness of a finger, and several feet in length. These disks were in circulation as a medium of exchange, and only a few of the chiefs had the right to make and issue them." Some other facts are mentioned, which seem to indicate that

Chinese Copper Cash (ancient coins).

Kingsmill Island Shell-Money (white and black).



California Shell-Money (various sizes).

Shell-Disks from Illinois Mounds (ancient).

Ancient Wampum from Mounds.

Shell-Disks from Huron Graves.

Large Wampum-Bead from Onondaga (recent).

Small Wampum-Beads, white and purple (recent).

this tortoise-shell money had an important place in the social usages of the people.

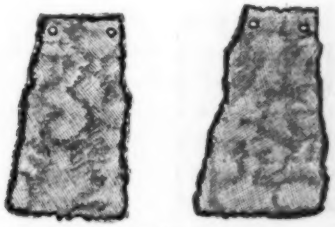
This ancient currency of the Ladrones was evidently the same with the supposed bead-ornaments of the Kingsmill-Islanders, except that the latter use other shells instead of that of the tortoise. But, when the nature of the commodity became apparent, some noteworthy inferences were drawn from it. As has been already observed, some of the customs and much of the mythology of the Micronesian Islanders seem to have sprung from communication with Northeastern Asia. This peculiar currency takes us in the same direction. The most common Chinese coins, their copper *cash*, have a hole through the center, are strung upon strings, and disposed of by lengths. This money is in use in the Loo-Choo Islands, midway between Micronesia and China. In Beechey's voyage to the Pacific, speaking of the assertion hastily made by Captain Basil Hall, that the people of Loo-Choo have no money, he says, "Our meeting with this peasant, however, disclosed the truth, as he had a string of *cash* (small Chinese money) suspended to his girdle, in the manner adopted by the Chinese." In a foot-note he adds, "These coins, being of small value, are strung together in hundreds, and have a knot at each end, so that it is not necessary to count them."

But evidence still more remarkable is afforded by the very valuable "Monograph on the History of Money in China," which we owe to Mr. Alexander Del Mar, late of the United States Monetary Commission, and author of "A History of the Precious Metals," and other works. He mentions a curious fact recorded in the great Chinese encyclopædia of the Emperor Kang-he, who reigned in the early part of the last century. In this work it is stated that "in ancient times the money of China was of tortoise-shell." How far back we must go for these "ancient times" is sufficiently shown, as Mr. Del Mar remarks, by the fact that Kang-he himself possessed a cabinet of metallic coins dating from the reign of Yaou, B. C. 2347; and the Chinese annalists assert that metal coins were known in the time of Fuh-he, six hundred years before the date just recorded. From this it might seem that nearly five thousand years have elapsed since this tortoise-shell money was in common use in China. But, from what we know of the conservative temperament of the Chinese, it seems highly probable that many centuries must have passed before the clumsy and burdensome copper coins completely superseded the lighter and more convenient tortoise-shell disks and slips. Cowries are used to this day, along with metallic coins, in some parts of the East Indies. It is not unlikely that the total disappearance of the shell-money from the currency of China dates from the period when paper-money first came into use in that empire, which is said to have been in the reign of Woo-te, about one hundred and forty years before the Christian era.

Some very ancient Chinese coins are still preserved in the cabinets

of antiquarians. Mr. Del Mar gives us pictures of several of these, the earliest being a coin of the Emperor Sung, dating 2257 years before Christ. These early coins are of various shapes, some being round with a square or round hole in the center, and some oblong with a hole at one end, evidently for stringing them. These oblong coins are spoken of as knife-shaped or bell-shaped, though the resemblances thus indicated are not very apparent. Dr. Tylor, whose careful research no evidence of this nature escapes, observes, in his standard work on "Anthropology," that "perhaps the earliest money may have been the Chinese little marked cubes of gold, and the pieces of copper in the shape of shirts and knives, as though intended to represent real shirts and knives." This is certainly an acute and striking suggestion; but we have to consider that the circular pieces, the most common of all, could hardly have been intended to represent any implement or other object of traffic. And when we refer to California, where, as has been seen, oblong pieces of shell, perforated at one end, were used as a variety of their currency, we are led to suppose that the early copper coins of the Chinese, both oblong and round, derived their shapes from imitation of the still earlier disks and strips of tortoise-shell which they superseded.

Ancient Chinese Coins.

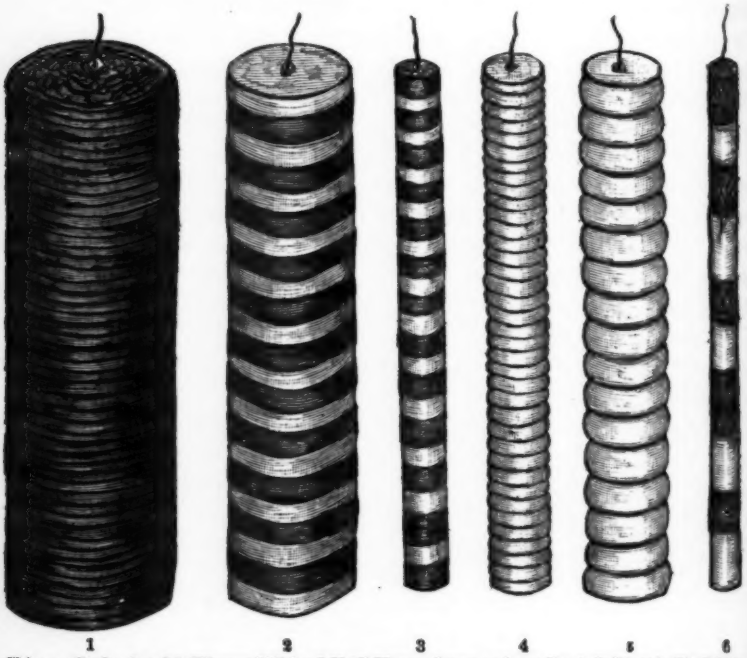


Ulio.—Oblong Shell-Money of California.

A singular usage still prevailing in China seems to point back to a time when the ordinary money was made of some combustible material. "Mock-money," as it is called, is composed of tin-foil and paper, and this is burned in large quantities at funerals and in sacrifices to the gods. In California, as has been seen, the Indians were accustomed to burn their shell-money in a similar manner. The Eastern Indians buried wampum with their dead, and burned it in their sacrifices.

Thus shell-money of this peculiar description, composed of small circular disks, perforated and strung together, and used both as currency and also (so far as our information extends) in important public and religious ceremonies, has been traced from the eastern coast of North America westward across the continent to California, and thence through the Micronesian Archipelago to China. In no other parts of the world, except those situated along or near this line (as in some parts of Melanesia), has the use of this singular currency been known. It is possible, of course, that the custom may have originated inde-

pendently in each of the four principal regions in which it existed—that is, in China, Micronesia, California, and Eastern North America. Few persons, however, will be inclined to doubt that the Micronesians received this invention from Eastern Asia; and, at the other end of the line, the transmission of the usage from one side of the Rocky Mountains to the other will seem equally probable. The only question will be as to its passage across the Pacific. The fact recorded by Dr. Wilson, in his work already quoted, that in 1833 a Japanese junk was wrecked on the coast of Oregon, and that some of her crew were sub-



1 2 3 4 5 6

1, Chinese Cash; 2 and 3, Kingsmill Island Shell-Money (large and small); 4, California Shell-Money (small); 5, Wampum (large), all white; 6, Wampum (small), white and purple.

sequently rescued from captivity among the Indians of that region, will show how easily this transmission might have been made. Nor is this the only instance known. Mr. Charles Wolcott Brooks, in his report on Japanese vessels wrecked in the North Pacific Ocean, read before the California Academy of Sciences in March, 1876, states that "one of these junks was wrecked on the Queen Charlotte Islands in 1831, and numerous others have been wrecked on other parts of the Northwest coast."

In certain respects the history of money bears a notable resemblance to the history of the alphabet, or rather of written speech. Nations have attained a high degree of civilization without a knowledge of either of these inventions; and each invention, when once known, has spread widely and rapidly through populations in very dif-

ferent stages of social progress. The alphabet, from a rude and vague beginning in Egypt, passed thence through Phœnicia to Greece, where it was perfected, and whence, in a few centuries, it was diffused to India on the one side and to Scandinavia and Britain on the other. In like manner coined money, vaguely beginning, as some suppose, with the scarabæi of Egypt, was brought to perfection in Greece, and thence spread through many civilized nations of Asia and among the semi-barbarous communities of Western Europe.

Both the art of writing and the use of money seem to have had an indigenous origin in China. The Chinese written character has spread through a large part of Eastern Asia. The Chinese currency, in its ancient form of shell-money, appears to have had a still wider diffusion. It has spread, apparently, through the islands of the North Pacific, and, either thence or directly from China or Japan, has been carried across the ocean to California, and so found its way eastward to the Ohio Valley and the Atlantic coast.

The fact, if it be a fact, that the Indians of the west coast of America received their monetary system from Eastern Asia or from the Pacific Islands, could not in itself be regarded as affording evidence that America was first peopled from that direction, just as the fact that the coinage of Bactria was derived from Greece would not indicate that the Bactrian population was of Grecian origin. All that we could infer would be some early intercourse, such as recent experience warrants us in supposing. A Chinese junk, or a large Micronesian *prao*, drifting to the Californian coast some three or four thousand years ago, would sufficiently explain the introduction of an art so easily learned as that of making and using perforated shell-disks for money.

PROGRESS IN TORNADO-PREDICTION.

By WILLIAM A. EDDY.

DURING the first part of 1884 the United States Signal Service began to pay special attention to the question of tornado-prediction. The development of the science was rapid under the active supervision of Lieutenant John P. Finley, having charge of that department of the service. It was found that the public interest in the question was wide-spread, and that, with the aid of voluntary reporters of tornado-phenomena, the possibility of saving life and property had begun to crystallize into a practical scheme. The power to verify predictions could only be obtained from two sources—from the press, and from tornado-reporters, who would voluntarily report the phenomena with some approach to scientific accuracy. The distinctions between a cyclone, five hundred or a thousand miles across the storm-

center, a hurricane of more limited extent, and a tornado with a path only one thousand feet in width—all these must be properly classified before any system for the prediction of tornadoes could reach even approximately verified results. The number of tornadoes occurring in the region east of the Rocky Mountains was one hundred and seventy-two in 1884. The average is more than a hundred yearly. Whenever a tornado occurred, blanks specifying the questions to be asked and the method of investigation to be followed were at once sent to the postmaster or to the principal city or town officers in the vicinity of the scene of destruction, asking for facts, and requesting that the observer would kindly volunteer to continue a series of easy meteorological observations for the Signal Service, involving no more outlay of time than the reporter could conveniently spare. The result of this clever device was that the Signal-Office now has upon its books the addresses of more than fifteen hundred reporters in all parts of the country east of the Rocky Mountains, and especially in those States most frequently stricken with destructive tornadoes. Having thus organized a system whereby something like verification of tornado-predictions could be attained, Lieutenant Finley then divided the territory east of the Rocky Mountains into eighteen districts. He at once began making predictions in these districts, thus reaching a series of recorded averages whereby the results became more definite and local until the close of 1884 and the summer of 1885. The predictions in the latter year have become so effective that during the summer of 1886 it is hoped that, by means of signals, hundreds of lives and much valuable property will be saved.

The most striking examples of the knowledge attained regarding tornadoes are found by reference to the following statistics: During 1884, 3,228 predictions unfavorable to tornadoes were made, and of these, 3,201 were verified by reports sent in by tornado-reporters, who are instructed to carefully scan the newspapers as well as note the meteorological phenomena in a given neighborhood. When the conditions are unfavorable for the development of tornadoes, there are no unusual contrasts of temperature, the areas of warm and cold air are neither great nor well defined northward and southward, the winds are variable and not very strong, and the distribution of pressure is about normal.

When we consider that more than a hundred tornadoes occur annually, it follows that the successful prediction of safety for eighteen districts is a very satisfactory indication of the advance made by this science. The result is certainly practical and valuable, as with proper signals shown at telegraph-stations the inhabitants of Kansas, Missouri, and other States, can go to their work free from anxiety and not subject to false alarms on the appearance of every harmless thunder-storm. The predictions of safety are therefore particularly valuable in States in which tornadoes are frequent. When, however, we examine the

statistics regarding the actual occurrence of tornadoes, we find the certainty lessened by the fact that the present limited resources of the Signal Service result in defective reports or in none at all from sparsely settled regions. Lieutenant Finley found that of thirty-eight predictions that tornadoes would occur, made in April and June, 1884, eighteen were verified, and that of nineteen predictions made in June and July, 1885, fifteen were generally verified. In all cases there were violent storms, either tornadoes, hurricanes, or hail. Owing to the extremely local nature of tornadoes, their tracks at times being only a mile or two in length and a few hundred feet in width, it is obvious that many predictions must apparently fail, owing to the fact that the effects are not seen until long afterward, or not at all where there are vast stretches of treeless prairie. It is doubtless true that this failure, due to the vagueness and unsatisfactory nature of the reports, induced Professor T. B. Maury to maintain, as late as 1882, that the prediction of a tornado was a triumph not yet attained by the science of meteorology, though doubtless he believed that success would be achieved at no very distant day. In order that the reader may see some of the reasons for expected progress in this science, let us examine, first, the methods in use by Lieutenant Finley for tracing the movement of air-masses, and second, the movement of the air-currents in the tornado-cloud, as seen by hundreds of observers.

It is well known that, owing to frequent telegraphic reports, the pressure, temperature, cloud-formation, extent, and movement of immense masses of air are permanently recorded. The conditions favorable to tornadoes are positive and noticeable. The areas of warm southerly and cold northerly winds are well defined, uniform, of large extent, and reach well to the north and south. High contrasts of humidity, abnormal variations in dew-point, the location of areas of barometric minima and maxima, with their lines of actual and probable progressive movement, and especially the velocity and direction of the wind, must be considered and mapped out on special charts. The temperatures are thrown out of their usual equilibrium and normal distribution over an extent at times of two thousand miles of territory. The cold air encroaches far into the Southern States, and the warm air of the South at such times may stream northward during a week or ten days. The movement in readjusting the equilibrium is like two pendulums thrown far apart which swing toward their common center with a force proportioned to the extent of their displacement. But this simple simile only fits the case roughly, because the questions of wind-direction, the location of the moving center of low pressure, and especially the inequality of the displacement of the air-masses north and south, make the problem very complex. Lieutenant Finley says that "the departure from normal conditions of temperature in case of tornado development is from 15° to 50°, but with this abnormal condition of temperature there must be abnormal conditions of humidity,

abnormal conditions of pressure, of wind-direction, of cloud-formation and movement."

The most remarkable and interesting feature of the development of tornadoes is the fact that they nearly always form southeast of a moving center of low pressure, and their tracks, scattered here and there, conform closely to the progressive direction of the main storm. For example, on February 19, 1884, forty-four tornadoes occurred in Georgia, Alabama, and South Carolina, but principally in Georgia and Alabama. They developed at a distance of from five hundred to two thousand miles from a storm-center that moved across the northern part of the United States, beginning at the northern extremity of the Rocky Mountains in Montana, thence southeasterly through Dakota, Minnesota, and Wisconsin to Northern Illinois and Indiana, northward through Michigan across Lake Huron, disappearing north of Quebec. This sudden sharp turn of the storm-center southward into Illinois and Indiana seems to have relation to the unprecedentedly large number of tornadoes that developed not far from the South Atlantic coast, extending inland as far as Southern Illinois and Indiana. This southward lunge of a mass of cold, moist air seems to have caused the abnormal conditions of temperature and dew-point, and the high winds necessary to cause the most tremendous exhibition of destructive tornado-power ever recorded by the Signal Service. This invariable location southeast of the storm-center is one of the main peculiarities of tornado development upon which the predictions depend.

One of the best illustrations of the advance made in definiteness in prediction during 1885 occurred on August 3d, in the instance of the tornado at Camden, New Jersey, and at Philadelphia, Pennsylvania. In October, 1885, the writer had sent a short communication to the press of the country, advocating that tornado-signals of either safety or danger be shown during certain seasons of the year at all telegraph stations in States in which tornadoes are frequent. The gentlemen of the press had generally favored the scheme, and one of the editors wanted to know if the tornado at Camden had been predicted. It occurred at 3.20 P. M. (seventy-fifth meridian time), and was very destructive, involving a loss of about half a million dollars' worth of property. The chart used by Lieutenant Finley shows that tornadoes were predicted and their location marked upon the map for the States of Delaware, Southeastern Pennsylvania, and for New Jersey. The tornadoes actually occurred in these States about eight hours from the time of the prediction, which was made on the basis of the 7 A. M. (seventy-fifth meridian time) telegraphic reports. On that day heavy wind-storms were predicted for Vermont, New Hampshire, Massachusetts, New York, Northern New Jersey, and Eastern Pennsylvania. Nature carried out these predictions with as fair a degree of accuracy and with as definite a conformity to location as could be expected at the present primary stage of this science.

The accumulations of great quantities of evidence concerning tornadoes have revealed some interesting facts. It is supposed that certain localities in the Eastern States are entirely free from tornadoes, but an examination of Lieutenant Finley's record from 1794 to 1881 shows that they at times approach dangerously near the most unexpected localities. One occurred in New York city, July 13, 1859, and this fact has been further emphasized by the appearance of another at Westwood, New Jersey, October 4, 1885, only twenty-one miles above the city, and not far from the Hudson River. Of the six hundred tornadoes recorded from 1794 to 1881, sixty-two occurred in Kansas, fifty-three in Illinois, forty-three in Missouri, thirty-five in New York, thirty-three in Georgia, thirty-two in Iowa, twenty-eight in Ohio, twenty-five in Indiana, twenty-two in Minnesota, eighteen in North Carolina, eighteen in Pennsylvania, eighteen in Texas, eighteen in Tennessee, fourteen in South Carolina, fifteen in Michigan, fourteen in Alabama, fourteen in Nebraska, fourteen in Mississippi, ten in Louisiana, ten in Wisconsin, nine in Massachusetts, nine in Dakota, nine in Virginia, eight in Arkansas, eight in Maryland, five in Connecticut, six in Kentucky, five in Florida, five in New Hampshire, six in New Jersey, three in Maine, two in Arizona, two in Vermont, and one each in Colorado, California, Indian Territory, Nevada, New Mexico, Montana, Rhode Island, West Virginia, and Wyoming Territory. The above figures are defective, owing to the absence of records in the past, but it may be accepted as an undoubted fact, soon to be demonstrated by the more careful system of investigation to be carried on by an army of tornado-reporters, that the proportion of tornadoes in Kansas, Missouri, Iowa, and Wisconsin is much greater than shown. The real prevalence in these States, as compared with others, is better represented by the record of unusually destructive tornadoes. Of this class Kansas leads with twenty-five, Illinois follows with fifteen, then come Iowa and Missouri with twelve each. The Eastern States disappear from the list with the exception of Pennsylvania three and Connecticut one—the well-known destruction of life and property at Wallingford. Of the six hundred tornadoes, three hundred and four moved from southwest to northeast, and the remainder, with marvelously few exceptions, kept very close to that direction. So comparatively certain is this movement that the tornado-track can be escaped by running southeast, depending, of course, upon the direction from which the storm is seen. Northwest is not so safe a direction to take, because so many move northward, veering very slightly eastward. The length of the track varies from one to one hundred and fifty miles, and the average is thirty miles. The average width of the storm-path is one thousand and eighty-five feet, and the velocity of progression is about thirty miles an hour. The form of the cloud is almost invariably funnel-shaped, varied at times with that of the hour-glass, cone, and inverted funnel, modifications caused by differ-

ent altitudes and velocities of air-currents. It is estimated that in the center of the funnel the air sometimes attains the enormous speed of two thousand miles an hour. The whirling movement is almost invariably in an opposite direction from that taken by the hands of a clock.

The weather-predictions of the Signal Service are distinct from the tornado-predictions, which involve local treatment that severely tests the science of meteorology. It is true the tornado region follows the usual storm-center along parallel lines, but at a distance of several hundred miles. The tornadoes develop far from the storm-center, and generally under conditions of partial sunshine and cloudiness and high humidity or excess of moisture. The relation of tornado-prediction to the usual weather-service is only in regard to details of temperature, wind-direction, dew-point, etc., as furnished by the general weather reports. The prediction of the movement of the usual storm-center is by no means so difficult as the attempt to even approximately locate the general region where a series of tornadoes will occur, because of the narrow track in which the destructive power is manifested. The officers of the Signal Service are careful to make no rash promises. While knowledge of the phenomena is not entirely complete, yet the advancement of the science is so marked and positive that tornadoes can be predicted for certain parts of States with a degree of average certainty that will, if carried out by the establishment of a system of signals in 1886, prove of very great value to the people. Already insurance companies have been enabled to take millions of dollars of tornado risks, and the more complete knowledge of the average danger for given localities will set the questions of premiums and rates of insurance upon a basis that will be profitable for the people as well as for the companies. The danger in localities will be established by averages, and the amount of precaution necessary will be known, and may be expressed in trustworthy percentages. This will economize expenditure both for insurance and tornado-retreats underground. The protection to life will be a very marked feature of the results attained. The approach of the tornado along its almost inevitable path, of from southwest to northeast, can be seen for fully an hour above the surface of a flat prairie, thus enabling people to get far beyond the reach of its narrow but fearfully destructive path. With this we close the question of the prediction of tornadoes for certain parts of States.

Let us now examine the closer prediction made by the trained observer or tornado-reporter, as he sees the tornado-cloud in process of formation. The question as to whether the furious movement of the clouds is forming the funnel-shape so much dreaded can only be decided by careful study of the sights and sounds described by hundreds of observers. A very important characteristic of tornado air-currents is that the disturbance begins in the upper air. In the "North American Review" for September, 1882, Professor T. B.

Maury, in an article entitled "Tornadoes and their Causes," attributes the peculiar movement of our tornadoes to an upper air-current, which at times has been seen to be "moving from the southwest at the rate of one hundred miles an hour." In addition to this, Lieutenant Finley's descriptions of the thirteen tornadoes that occurred in Kansas, May 29 and 30, 1879, give abundant evidence that the southwest air-current forces the contest. Innumerable descriptions show that the cloud in the northwest is heavy, black, and comparatively slow in its movement, until struck by a light, rather smoky, and more rapidly moving cloud from the southwest. Then the clouds rush to a common center, and there is a violent conflict of currents, driving clouds in every direction, up and down, round and round. Clouds like great sheets of white smoke dash about in a frightful manner, with such unnatural velocity that the observer is often panic-stricken, and flees to the nearest cellar for safety. Finally a black, threatening mass descends slowly toward the earth, whirling violently, but still manifesting confusion in form. This soon gives place to the peculiar funnel-like shape, with definite outline so well known. It appears intensely black, like coal-smoke issuing from a locomotive, and its trunk-like form sometimes has a wrenching, spiral motion, like a snake hung up by the head and writhing in agony. As white clouds approach and are drawn into the vortex, the funnel-shaped trunk sways like an elastic column. It sometimes rises, falls, and careens from side to side like a balloon. Branches and trunks of trees, rails, tree-tops, roofs, pieces of houses, straw, furniture, stoves, iron-work, lumber, and other *débris* are seen flying about in the central part of the cloud, but are gradually drawn upward and thrown out near the top, usually not until the storm has progressed a mile or two farther on from a given point. Dark masses of cloud are seen to shoot downward on either side of the funnel, to enter it just above the ground, and to apparently rush upward through the center and out at the top in a terrific manner. Sometimes the funnel pauses and whirls with apparently increased velocity, reducing everything to splinters, and leaving scarcely a vestige of a house or clump of trees, all being ground comparatively fine and carried away as chaff. At Westwood, New Jersey, October 4, 1885, fully three quarters of a school-house was carried away from the foundation. Its fragments were scattered along the storm's track for about half a mile, and the rest was seen no more. The people at Westwood describe the roar of the tornado as having a peculiar hollow, humming sound. It somewhat resembled the rumbling of cars, or the booming of the sea. The sound is indescribable and unlike any other in Nature. It is so loud that the falling of heavy trees against the side of a house and the crash of falling buildings are lost in the general roar. These facts attest the tremendous rapidity of the air-currents.

In addition to a downward movement of air, there is also a violent

reactionary upward movement through the center of the funnel. This center is almost a vacuum surrounded by a cylindrical mass of air of great density and revolving force. Professor William M. Davis, of Harvard College, whose work, entitled "Whirlwinds, Cyclones, and Tornadoes," is well known for its merit and originality, maintains that the destructive power of a tornado is due to the rush of air along the earth's surface toward the vacuum center of the funnel. Some buildings have a stricken, pinched appearance at the top, as if the air had rushed under the edge of a huge cylinder, and swept upward with tremendous power. While it is true that the downward movement predominates, yet the upward movement in the center is equally marked. The iron grip of the tornado-funnel is relieved only by the escape of currents to the upper air through its center, and this again is doubtless due to the decrease of the contrasts of temperature between the opposing currents, thus gradually lessening the air-movement. In the Westwood tornado, when the funnel had gone about a mile northeast of the village, it became thinner, and the distance to the top of the revolving column did not seem more than one hundred feet. As its force still further weakened, it became only a shallow, whirling cloud of *débris*, six or seven feet above the ground, and about fifty feet in width. These facts present a problem of the relation of air-pressures in which we may look for destructive action in proportion to the height of the column of revolving air.

Lieutenant Finley's interesting studies will soon be of great service to the people. The advancement of the science of meteorology, as well as of other sciences, has always been made through those whose energy in the examination of these subjects has been manifested as an intrinsic liking, regardless of personal gain, a characteristic pointed out long ago by Jean Paul Richter, and reaffirmed by Emerson as the true aim of the scholar. It has been thought that the time will come when greater numbers of men of leisure and means will become steady workers along paths of unprofitable public usefulness. The people look for science to come to their rescue regarding certain evils in politics or in commerce, in over-legislation, in physical and mental life, and in the destruction of life and property by the elements. It does not follow that the service will be rewarded, yet the control or anticipation of any form of destructive action in Nature is a benefit that will live in the annals of the race for many a century.

THE VARIETIES OF THE HUMAN SPECIES.*

By Professor WILLIAM H. FLOWER, F.R.S.

THE most ordinary observation is sufficient to demonstrate the fact that certain groups of men are strongly marked from others by definite characters common to all members of the group, and transmitted regularly to their descendants by the laws of inheritance. The Chinaman and the negro, the native of Patagonia and the Andaman-Islander, are as distinct from each other structurally as are many of the so-called species of any natural group of animals. Indeed, it may be said with truth that their differences are greater than those which mark the groups called genera by many naturalists of the present day. Nevertheless, the difficulty of parceling out all the individuals composing the human species into certain definite groups, and of saying of each man that he belongs to one of other of such groups, is insuperable. No such classification has ever, or indeed, can ever, be obtained. There is not one of the most characteristic, most extreme forms, like those I have just named, from which transitions can not be traced by almost imperceptible gradations to any of the other equally characteristic, equally extreme, forms. Indeed, a large proportion of mankind is made up, not of extreme or typical, but of more or less generalized or intermediate, forms, the relative numbers of which are continually increasing as the long-existing isolation of nations and races breaks down under the ever-extending intercommunication characteristic of the period in which we dwell.

The difficulties of framing a natural classification of man, or one which really represents the relationship of the various minor groups to each other, are well exemplified by a study of the numerous attempts which have been made from the time of Linnæus and Blumenbach onward. Even in the first step of establishing certain primary groups of equivalent rank there has been no accord. The number of such groups has been most variously estimated by different writers from two up to sixty, or more, although it is important to note that there has always been a tendency to revert to the four primitive types sketched out by Linnæus—the European, Asiatic, African, and American—expanded into five by Blumenbach by the addition of the Malay, and reduced by Cuvier to three by the suppression of the last two. After a perfectly independent study of the subject, extending over many years, I can not resist the conclusion, so often arrived at by various anthropologists, and so often abandoned for some more complex system, that the primitive man, whatever he may have been, has in the course of ages divaricated into three extreme types, represented by the

* From the President's Anniversary Address to the Anthropological Institute of Great Britain and Ireland, January 27, 1885.

Caucasian of Europe, the Mongolian of Asia, and the Ethiopian of Africa, and that all existing individuals of the species can be ranged around these types, or somewhere or other between them. Large numbers are doubtless the descendants of direct crosses in varying proportions between well-established extreme forms; for, notwithstanding opposite views formerly held by some authors on this subject, there is now abundant evidence of the wholesale production of new races in this way. Others may be the descendants of the primitive stock, before the strongly marked existing distinctions had taken place, and therefore present, though from a different cause from the last, equally generalized characters. In these cases it can only be by most carefully examining and balancing all characters however minute, and finding out in what direction the preponderance lies, that a place can be assigned to them. It can not be too often insisted on that the various groups of mankind, owing to their probable unity of origin, the great variability of individuals, and the possibility of all degrees of intermixture of races at remote or recent periods of the history of the species, have so much in common that it is extremely difficult to find distinctive characters capable of strict definition by which they may be differentiated. It is more by the preponderance of certain characters in a large number of members of a group, than by the exclusive or even constant possession of these characters in each of its members, that the group as a whole must be characterized.

Bearing these principles in mind, we may endeavor to formulate, as far as they have as yet been worked out, the distinctive features of the typical members of each of the three great divisions, and then show into what subordinate groups each of them seems to be divided.

To begin with the Ethiopian, Negroid, or Melanian, or "black" type. It is characterized by a dark, often nearly black, complexion; black hair, of the kind called "frizzly," or, incorrectly, "woolly," i. e., each hair being closely rolled up upon itself, a condition always associated with a more or less flattened or elliptical transverse section; a moderate or scanty development of beard; an almost invariably dolichocephalic skull; small and moderately retreating malar bones (mesopic face*); a very broad and flat nose, platyrhine in the skeleton; moderate or low orbits; prominent eyes; thick, everted lips; prognathous jaws; large teeth (macrodont); a narrow pelvis (index in the male 90 to 100); a long fore-arm (humero-radial index 80), and certain other proportions of the body and limbs which are being gradually worked out and reduced to numerical expression as material for so doing accumulates.

The most characteristic examples of the second great type, the Mongolian or Xanthous or "yellow," have a yellow or brownish complexion; coarse, straight hair, without any tendency to curl, and nearly

* Oldfield Thomas, in a paper read before the Anthropological Institute, January 13, 1885.

round in section, on all other parts of the surface except the scalp, scanty and late in appearing; a skull of variable form, mostly mesocephalic (though extremes both of dolichocephaly and brachycephaly are found in certain groups of this type); a broad and flat face, with prominent anteriorly projecting malar bones (platyopic face); nose small, mesorhine or leptarhine; orbits high and round, with very little development of glabella or supraciliary ridges; eyes sunken, and with the aperture between the lids narrow; in the most typical members of the group with a vertical fold of skin over the inner canthus, and with the outer angle slightly elevated; jaws mesognathous; teeth of moderate size (mesodont); the proportions of the limbs and form of the pelvis have yet to be worked out, the results at present obtained showing great diversity among different individuals of what appear to be well-marked races of the group, but this is perhaps due to the insufficient number of individuals as yet examined with accuracy.

The last type, which, for want of a better name, I still call by that which has the priority, Caucasian, or "white," has usually a light-complexioned skin (although in some, in so far aberrant cases, it is as dark as in the negroes); hair fair or black, soft, straight, or wavy, in section intermediate between the flattened and cylindrical form; beard fully developed; form of cranium various, mostly mesocephalic; malar bones retreating; face narrow and projecting in the middle line (pro-opic); orbits moderate; nose narrow and prominent (leptorhine); jaws orthognathous; teeth small (microdont); pelvis broad (pelvic index of male 80); fore-arm short, relatively to humerus (humero-radial index 74).

In endeavoring further to divide up into minor groups the numerous and variously modified individuals which cluster around one or other of these great types, a process quite necessary for many practical or descriptive purposes, the distinctions afforded by the study of physical characters are often so slight that it becomes necessary to take other considerations into account, among which geographical distribution and language hold an important place.

I. The Ethiopian or Negroid races may be primarily divided as follows:

A. African or typical negroes—inhabitants of all the central portion of the African Continent, from the Atlantic on the west to the Indian Ocean on the east, greatly mixed all along their northern frontier with Hamitic and Semitic Melanochroi, a mixture which, taking place in various proportions, and under varied conditions, has given rise to many of the numerous races and tribes inhabiting the Soudan.

A branch of the African negroes are the Bantu—distinguished chiefly, if not entirely, by the structure of their language. Physically indistinguishable from the other negroes where they come in contact in the equatorial regions of Africa, the Southern Bantu, or Caffres, as they are generally called, show a marked modification of type, being

lighter in color, having a larger cranial capacity, less marked prognathism, and smaller teeth. Some of these changes may possibly be due to crossing into the next race.

B. The Hottentots and Bushmen form a very distinct modification of the negro race. They formerly inhabited a much larger district than at present; but, encroached upon by the Bantu from the north, and the Dutch and English from the south, they are now greatly diminished, and indeed threatened with extinction. The Hottentots especially are much mixed with other races, and, under the influence of a civilization which has done little to improve their moral condition, they have lost most of their distinctive peculiarities. When pure-bred they are of moderate stature, have a yellowish-brown complexion, with very frizzly hair, which, being less abundant than that of the ordinary negro, has the appearance of growing in separate tufts. The forehead and chin are narrow, and the cheek-bones wide, giving a lozenge-shape to the whole face. The nose is very flat, and the lips prominent. In their anatomical peculiarities, and almost everything except size, the Bushmen agree with the Hottentots; they have, however, some special characters, for while they are the most platyrhine of races, the prognathism so characteristic of the negro type is nearly absent. This, however, may be the retention of an infantile character so often found in races of diminutive stature, as it is in all the smaller species of a natural group of animals. The cranium of a Bushman, taken altogether, is one of the best marked of any race, and could not be mistaken for that of any other race. Their relation to the Hottentots, however, appears to be that of a stunted and outcast branch, living the lives of the most degraded of savages among the rocky caves and mountains of the land of which the comparatively civilized and pastoral Hottentots inhabited the plains.

Perhaps the Negrillos of Hamy, certain diminutive, round-headed people of Central and Western Equatorial Africa, may represent a distinct branch of the negro race, but their numbers are few, and they are very much mixed with the true negroes in the districts in which they are found. They form the only exceptions to the general dolichocephaly of the African branch of the negro race.

C. *Oceanic Negroes* or *Melanesians.*—These include the Papuans of New Guinea and the majority of the inhabitants of the islands of the Western Pacific, and form also a substratum of the population, greatly mixed with other races, of regions extending far beyond the present center of their area of distribution.

They are represented, in what may be called a hypertypical form, by the extremely dolichocephalic Kai Colos, or mountaineers of the interior of the Feejee Islands, although the coast population of the same group have lost their distinctive characters by crossing. In many parts of New Guinea and the great chain of islands extending eastward and southward ending with New Caledonia, they are found in

a more or less pure condition, especially in the interior and more inaccessible portions of the islands, almost each of which shows special modifications of the type recognizable in details of structure. Taken altogether their chief physical distinction from the African negroes lies in the fact that the glabella and supra-orbital ridges are generally well developed in the males, whereas in Africans this region is usually smooth and flat. The nose, also, especially in the northern part of their geographical range, New Guinea, and the neighboring islands, is narrower (often mosorhine) and prominent. The cranium is generally higher and narrower. It is, however, possible to find African and Melanesian skulls quite alike in essential characters.

The now extinct inhabitants of Tasmania are probably pure but aberrant members of the Melanesian group, which have undergone a modification from the original type, not by mixture with other races, but in consequence of long isolation, during which special characters have gradually developed. Lying completely out of the track of all civilization and commerce, even of the most primitive kind, they were little liable to be subject to the influence of any other race, and there is in fact nothing among their characters which could be accounted for in this way, as they are intensely, even exaggeratedly, Negroid in the form of nose, projection of mouth, and size of teeth, typically so in character of hair, and aberrant chiefly in width of skull in the parietal region. A cross with any of the Polynesian or Malay races sufficiently strong to produce this would, in all probability, have also left some traces on other parts of their organization.

On the other hand, in many parts of the Melanesian region there are distinct evidences of large admixture with Negrito, Malay, and Polynesian elements in varying proportions, producing numerous physical modifications. In many of the inhabitants of the great Island of New Guinea itself and of those lying around it this mixture can be traced. In the people of Micronesia in the north, and New Zealand in the south, though the Melanesian element is present, it is completely overlaid by the Polynesian, but there are probably few, if any, of the islands of the Pacific in which it does not form some factor in the composite character of the natives.

The inhabitants of the continent of Australia have long been a puzzle to ethnologists. Of Negroid complexion, features, and skeletal characters, yet without the characteristic frizzly hair, their position has been one of great difficulty to determine. They have, in fact, been a stumbling-block in the way of every system proposed. The solution, supported by many considerations too lengthy to enter into here, appears to lie in the supposition that they are not a distinct race at all, that is, not a homogeneous group formed by the gradual modification of one of the primitive stocks, but rather a cross between two already formed branches of these stocks. According to this view, Australia was originally peopled with frizzly-haired Melanesians, such

as those which still do, or did till the recent European invasion, dwell in the smaller islands which surround the north, east, and southern portions of the continent, but that a strong infusion of some other race, probably a low form of Caucasian Melanochroi, such as that which still inhabits the interior of the southern parts of India, has spread throughout the land from the northwest, and produced a modification of the physical characters, especially of the hair. This influence did not extend across Bass's Strait into Tasmania, where, as just said, the Melanesian element remained in its purity. It is more strongly marked in the northern and central parts of Australia than on many portions of the southern and western coasts, where the lowness of type and more curly hair, sometimes closely approaching to frizzly, show a stronger retention of the Melanesian element. If the evidence should prove sufficiently strong to establish this view of the origin of the Australian natives, it will no longer be correct to speak of a primitive Australian, or even Australoid, race or type, or look for traces of the former existence of such a race anywhere out of their own land. Proof of the origin of such a race is, however, very difficult if not impossible to obtain, and I know nothing to exclude the possibility of the Australians being mainly the direct descendants of a very primitive human type, from which the frizzly-haired negroes may be an offset. This character of hair must be a specialization, for it seems very unlikely that it was the attribute of the common ancestors of the human race.

D. The fourth branch of the Negroid race consists of the diminutive, round-headed people called Negritos, still found in a pure or unmixed state in the Andaman Islands, and forming a substratum of the population, though now greatly mixed with invading races, especially Malays, in the Philippines, and many of the islands of the Indo-Malayan Archipelago, and perhaps of some parts of the southern portion of the mainland of Asia. They also probably contribute to the varied population of the great Island of Papua or New Guinea, where they appear to merge into the taller, longer-headed, and longer-nosed Melanesians proper. They show, in a very marked manner, some of the most striking anatomical peculiarities of the negro race, the frizzly hair, the proportions of the limbs, especially the humero-radial index, and the form of the pelvis; but they differ in many cranial and facial characters, both from the African negroes on the one hand, and the typical Oceanic negroes, or Melanesians, on the other, and form a very distinct and well-characterized group.

II. The principal groups that can be arranged around the Mongolian type are—

A. The Eskimo, who appear to be a branch of the typical North Asiatic Mongols, who in their wanderings northward and eastward across the American Continent, isolated almost as perfectly as an island population would be, hemmed in on one side by the eternal

polar ice, and on the other by hostile tribes of American Indians, with which they rarely if ever mingled, have gradually developed characters most of which are strongly expressed modifications of those seen in their allies who still remain on the western side of Behring Strait. Every special characteristic which distinguishes a Japanese from the average of mankind is seen in the Eskimo in an exaggerated degree, so that there can be no doubt about their being derived from the same stock. It has also been shown that these special characteristics gradually increase from west to east, and are seen in their greatest perfection in the inhabitants of Greenland; at all events, in those where no crossing with the Danes has taken place. Such scanty remains as have yet been discovered of the early inhabitants of Europe present no structural affinities to the Eskimo, although it is not unlikely that similar external conditions may have led them to adopt similar modes of life. In fact, the Eskimo are such an intensely specialized race, perhaps the most specialized of any in existence, that it is probable that they are of comparatively late origin, and were not as a race contemporaries with the men whose rude flint tools found in our drifts excite so much interest and speculation as to the makers, who have been sometimes, though with little evidence to justify such an assumption, reputed to be the ancestors of the present inhabitants of the northernmost parts of America.

B. The typical Mongolian races constitute the present population of Northern and Central Asia. They are not very distinctly, but still conveniently for descriptive purposes, divided into two groups, the Northern and the Southern.

a. The former, or Mongolo-Altaic group, are united by the affinities of their language. These people, from the cradle of their race in the great central plateau of Asia, have at various times poured out their hordes upon the lands lying to the west, and have penetrated almost to the heart of Europe. The Finns, the Magyars, and the Turks, are each the descendants of one of these waves of incursion, but they have for so many generations intermingled with the peoples through whom they have passed in their migrations, or have found in the countries in which they have ultimately settled, that their original physical characters have been completely modified. Even the Lapps, that diminutive tribe of nomads inhabiting the most northern parts of Europe, supposed to be of Mongolian descent, show so little of the special attributes of that branch, that it is difficult to assign them a place in it in a classification based upon physical characters. The Japanese are said by their language to be allied rather to the Northern than to the following branch of the Mongolian stock.

b. The Southern Mongolian group, divided from the former chiefly by language and habits of life, includes the greater part of the population of China, Thibet, Burmah, and Siam.

C. The next great division of Mongoloid people is the Malay, sub-

typical, it is true, but to which an easy transition can be traced from the most characteristic members of the type.

D. The brown Polynesians, Malayo-Polynesians, Maforis, Sawaioris, or Kanakas, as they have been variously called, seen in their greatest purity in the Samoan, Tongan, and Eastern Polynesian Islands, are still more modified, and possess less of the characteristic Mongolian features; but still it is difficult to place them anywhere else in the system. The large infusion of the Melanesian element throughout the Pacific must never be forgotten in accounting for the characters of the people now inhabiting the islands, an element in many respects so diametrically opposite to the Mongolian, that it would materially alter the characters, especially of the hair and beard, which has been with many authors a stumbling-block to the affiliation of the Polynesian with the Mongol stock. The mixture is physically a fine one, and in some proportions produces a combination, as seen, for instance, in the Maories of New Zealand, which in all definable characters approaches quite as near, or nearer, to the Caucasian type, than to either of the stocks from which it may be presumably derived. This resemblance has led some writers to infer a real extension of the Caucasian element at some very early period with the Pacific Islands, and to look upon their inhabitants as the product of a mingling of all three great types of men. Though this is a very plausible theory, it rests on little actual proof, as the combination of Mongolo-Malayan and Melanesian characters in different degrees to the local variations certain to arise in communities so isolated from each other and exposed to such varied conditions as the inhabitants of the Pacific Islands would probably account for all the modifications observed among them.

E. The native population (before the changes wrought by the European conquest) of the great Continent of America, excluding the Eskimo, present, considering the vast extent of the country they inhabit and the great differences of climate and other surrounding conditions, a remarkable similarity of essential characters, with much diversity of detail.

The construction of the numerous American languages, of which as many as twelve hundred have been distinguished, is said to point to unity of origin, as, though widely different in many respects, they are all, or nearly all, constructed on the same general grammatical principle—that called *polysynthesis*—which differs from that of the languages of any of the Old World nations. The mental characteristics of all the American tribes have much that is in common; and the very different stages of culture to which they had attained at the time of the conquest, as that of the Incas and Aztecs, and the hunting or fishing tribes of the North and South, which have been quoted as evidence of diversities of race, were not greater than those between different nations of Europe, as Gauls and Germans on the one hand, and Greeks and Romans on the other, in the time of Julius Cæsar. Yet all these

were Aryans, and in treating the Americans as one race it is not intended that they are more closely allied than the different Aryan people of Europe and Asia. The best argument that can be used for the unity of the American race—using the word in a broad sense—is the great difficulty of forming any natural divisions founded upon physical characters. The important character of the hair does not differ throughout the whole continent. It is always straight and lank, long and abundant on the scalp, but sparse elsewhere. The color of the skin is practically uniform, notwithstanding the enormous differences of climate under which many members of the group exist. In the features and cranium certain special modifications prevail in different districts, but the same forms appear at widely separated parts of the continent. I have examined skulls from Vancouver's Island, from Peru, and from Patagonia, which were almost undistinguishable from one another.

Naturalists who have admitted but four primary types of the human species have always found a difficulty with the Americans, hesitating between placing them with the Mongolian or so-called "yellow" races, or elevating them to the rank of a primary group. Cuvier does not seem to have been able to settle this point to his own satisfaction, and leaves it an open question. Although the large majority of Americans have in the special form of the nasal bones, leading to the characteristic high bridge of the nose of the living face, in the well-developed superciliary ridge and retreating forehead, characters which distinguish them from the typical Asiatic Mongol, in so many other respects they resemble them so much that, although admitting the difficulties of the case, I am inclined to include them as aberrant members of the Mongolian type. It is, however, quite open to any one adopting the Negro, Mongolian, and Caucasian as primary divisions, also placing the Americans apart as a fourth.

Now that the high antiquity of man in America, perhaps as high as that he has in Europe, has been discovered, the puzzling problem, from which part of the Old World the people of America have sprung, has lost its significance. It is quite as likely that the people of Asia may have been derived from America as the reverse. However this may be, the population of America had been, before the time of Columbus, practically isolated from the rest of the world, except at the extreme north. Such visits as those of the early Norsemen to the coasts of Greenland, Labrador, and Nova Scotia, or the possible accidental stranding of a canoe containing survivors of a voyage across the Pacific or the Atlantic, can have had no appreciable effect upon the characteristics of the people. It is difficult, therefore, to look upon the anomalous and special characters of the American people as the effects of crossing, as was suggested in the case of the Australians, a consideration which gives more weight to the view of treating them as a distinct primary division.

III. The Caucasian, or white division, according to my view, includes the two groups called by Professor Huxley Xanthochroi and Melanochroi, which, though differing in color of eyes and hair, agree so closely in all other anatomical characters, as far, at all events, as has at present been demonstrated, that it seems preferable to consider them as modifications of one great type than as primary divisions of the species.

Whatever their origin, they are now intimately blended, though in different proportions, throughout the whole of the region of the earth they inhabit; and it is to the rapid extension of both branches of this race that the great changes now taking place in the ethnology of the world are mainly due.

A. The Xanthochroi, or blonde type, with fair hair, eyes, and complexion, chiefly inhabit Northern Europe—Scandinavia, Scotland, and North Germany—but, much mixed with the next group, they extend as far as Northern Africa and Afghanistan. Their mixture with Mongoloid people in North Europe has given rise to the Lapps and Finns.

B. Melanochroi, with black hair and eyes, and skin of almost all shades from white to black. They comprise the great majority of the inhabitants of Southern Europe, Northern Africa, and Southwest Asia, and consist mainly of the Aryan, Semitic, and Hamitic families. The Dravidians of India, and probably the Ainos of Japan, the Maoutze of China, also belong to this race, which may have contributed something to the mixed character of some tribes of Indo-China and the Polynesian Islands, and, as before said, given at least the characters of the hair to the otherwise Negroid inhabitants of Australia. In Southern India they are probably mixed with a Negrito element, and in Africa, where their habitat becomes conterminous with that of the negroes, numerous cross-races have sprung up between them all along the frontier line. The ancient Egyptians were nearly pure Melanochroi, though often showing in their features traces of their frequent intermarriage with their Ethiopian neighbors to the south. The Copts and fellahs of modern Egypt are their little-changed descendants.

In offering this scheme of classification of the human species, I have not thought it necessary to compare it in detail with the numerous systems suggested by previous anthropologists. These will all be found in the general treatises on the subject. As I have remarked before, in its broad outlines it scarcely differs from that proposed by Cuvier nearly sixty years ago, and that the result of the enormous increase of our knowledge during that time having caused such little change is the best testimony to its being a truthful representation of the facts. Still, however, it can only be looked upon as an approximation. Whatever care be bestowed upon the arrangement of already acquired details, whatever judgment be shown in their due subordination one to another, the acquisition of new knowledge may at any time call for a complete or partial rearrangement of our system.

COMMUNAL SOCIETIES.

By CHARLES MORRIS.

IN the paper on "Neuter Insects," recently published in "The Popular Science Monthly,"* the argument on certain phases of animal evolution there presented was not offered as a complete one. For a full exposition of the development of ant and bee intelligence, this subject needs to be considered from another point of view, and the present paper is intended as, in a partial sense, a sequel to the one above named.

It is usual to divide animals, in respect to their habits of association, into two classes, the solitary and the social. The solitary animals comprise all those which form sexual combinations only, and the class embraces all those species of the smaller mammals and birds which flock together solely from the fact that they are very numerous, and seek food in the same localities, not from any association for mutual aid.

The social animals form true communities. They are banded together by certain common interests, and possess a principle of association beyond that of the sexual. They present the germinal condition of a political society. These comprise most of the large herbivora, which aggregate for purposes of common defense, in some cases stationing sentries for protection while feeding, and in others following certain acknowledged leaders. Instances of any such association are rare among carnivora, the wolves being the most marked example.

Yet in the social animals, as a rule, the common interests are few, and the links of association weak. Individuality largely persists, there is no idea of common property, and nearly or quite the only interest in common is that of attack or defense. Separated from these by a broad interval are some three or four animal tribes whose socialism is of so advanced a type that it fairly deserves to be indicated by a special name. These tribes comprise the ants, bees, and termites, among insects, and the beavers among mammals. Their conditions of association are so different from those prevailing in most other cases, that it seems proper to consider them as a separate class. I propose for them the title of *communal animals*, as most distinctive of their life-habits.

Instead of possessing a few links of combination, these animals have most or all of the relations of life in common. In ant and bee communities, for instance, individualism has vanished. All property is held in common, all labor is performed for the community, there are a common home, common stores, common duties, community alike in assault and defense, and it is difficult or impossible to detect any ant

* December, 1885.

or bee doing anything for itself alone, or performing any act which is not intended for the good of the community as a whole. Selfishness, so far as the home community is concerned, seems to have vanished, and labor and life are freely given for the good of this great whole, with no evident display of any thought of individual comfort or aggrandizement.

The communities of termites are communal in an equally complete sense, and seem to have utterly lost the selfish sentiment which is the ruling agency with solitary animals. With the beavers communalism has stopped somewhat short of this complete stage. They possess their dams and canals in common, and labor together in all the needs of out-door life. But they have not advanced to the stage of a common home, their habits rendering this impossible, or nearly so; and, though they seek food in common, each lodge lays up its own private stores. Yet their interests are so largely in common that they stand distinctly separate in this respect from the ordinary social vertebrates, and fairly belong to the communal class, in company with their insect analogues.

There is one further interesting and suggestive feature in these communal groups of animals, whose significance will be apparent when we come to consider the conditions of human communities. This is that they are family aggregates. The indefinite association of the social animals has become a strictly family association in the communal animals. This is not very clearly displayed in the beavers. Yet with them the inmates of each lodge probably belong to a single family, and form a group within the larger group. And the community as a whole may be descended from a single ancestor, like the members of the patriarchal family among men.

With the ants, bees, and termites this family association has gone much further, and each community constitutes a single family. Division of labor has proceeded to such an extent that the egg-bearing function is confined to one or a few members of the community, while all the sexual individuals beyond these perish. This principle has gone farthest with the bees, who permit but one female to develop for the use of each swarm, and who mercilessly destroy all the males, as soon as they become a burden on the community.

Thus it is evident that the conditions of communal life among animals can not fairly be claimed as merely advanced instances of socialism. They differ not only in regard to degree of community of interests, but also in displaying a new and distinct principle of association. The social group is a vague one, the communal a strictly defined one, which has gradually grown up in the midst of the older group and finally replaced it. Alike in ants, bees, and rodents, species exist in various stages of association, between the solitary and the communal, and could we trace all the steps of development we should undoubtedly perceive solitary animals gradually adopting social rela-

tions, and then family groups developing in the midst of the larger social groups, and acquiring special interests which render them finally hostile to other family groups. There can be but little question that the ants, termites, bees, and wasps, have passed through these various stages of association, and that the old social groups gradually broke up into minor family groups, which in turn have developed into extensive groups, combined on the principle of blood relationship.

This gradual evolution of the principle of association, beginning in the completely solitary or hermaphrodite tribes, and reaching its ultimate stage in the colonial or compound animals, of which we have a notable instance in the *Siphonophora*, or family compound of swimming polyps, in which the loss of individuality is complete, is a highly interesting phase of animal development, which we can not undertake to consider here as a whole. We may simply say that animals might be classified, from this point of view, as the truly solitary, the sexual, the social, the communal, and the colonial or compound.

The views above expressed lead directly to the consideration of primitive human societies, since these present a striking resemblance to those of the lower animals. The indications are, indeed, that the development of society everywhere follows one fixed course, and obeys one general law, and that human society has in no sense escaped this law, despite all the seeming irregularity of its development.

Man may properly be ranked with the ants, bees, and termites, as another instance of the communal animal, the beaver being his only vertebrate counterpart in this respect. Communalism probably did not exist with primitive man. He seems to have been originally a social animal, like the quadrumana, from whom it is assumed that he descended. Yet it is interesting to perceive that, at the opening of the historical period, the ancestors of all the present civilized races were in the communal stage of association, and under conditions which present a striking parallel to those of the lower tribes of communal animals.

Alike with the American Indians, the Mongolians and Semites of Asia, and the primitive Aryans, history opens with strongly declared instances of the communal type of association. The original social groups, with few interests in common, had been replaced by well-defined family groups, with nearly all interests in common. The ancient association vanished as this new association developed, and the family became the basis of all social organization. We might, had we space, consider at some length the evolution of this new condition of human society. It doubtless had its basis in that slowly growing energy of the marriage sentiment, whose development has been traced by several recent writers. The primitive weak sense of union between husband, wife, and children gradually grew into a strong bond of association, whose strength was added to by the possession of a separate family property, which increased in value with the development of society.

Thus in the heart of the old vague social group there grew up intimately associated family groups of increasing size and importance. The double link of property and blood-relationship rendered this association a strong one, and we seem to see the old social group gradually breaking up into its elements, with diversity of interests and a degree of hostility between the separate family groups. Each of these, in its turn, grew larger and larger, until it became a community in itself, held together by a strongly-felt sense of blood-relationship, and quite able to hold its own against other similar groups.

The most archaic of these communal groups is the patriarchal, that still found throughout nomadic Asia. It is distinctly based on family relations, recognizes a common ancestor, is governed by the living representative of this ancestor, and strongly holds to the fiction of blood relationship, even in adopted members of the tribe. Again, all property is held and all labor performed in common, and for the good of the community, while the sentiment of individualism is very greatly reduced. This is not now so strictly the case as it probably was of old, yet the principle of communalism is still strongly maintained.

Yet, as in the beavers, so in the patriarchal horde, there are minor groups within the group, tent-families like the lodge-family of the beavers, with more immediate family links than those of the larger group. Among the primitive Aryans this minor division had made great progress. The separation of the patriarchal community into minor family groups, with special interests and common property, had become strongly marked, and a reverse process of development, from communalism toward individualism, had fairly set in. The Aryan village community had still many interests in common, and held the fiction of a common ancestor. Yet it had taken a step in advance of the stage reached by the communal animals, toward the higher and special development of modern human society.

Between the patriarchal and the Aryan systems of association stands that of the Indian clan, which possessed features of both. The general family group was broken up into smaller family groups, as well defined as the Aryan, yet the division of property had not advanced so far. And not only property was held to a considerable extent in common, but common habitation existed among many tribes, of which we have the most marked and striking instance in the great common habitations of the Pueblo Indians of to-day.

In the later stages of human development there has been a strongly declared progress toward individualism, at least in property and political relations. The family association has vanished, and has been replaced by the *territorial*, which is the link of connection in all modern civilized societies, and the latest outgrowth of the principle of animal association. Yet industrially the communal principle holds good, though it has assumed a new and wider phase than that of old. Though the idea of community in property has lost its force, the senti-

ment that the labor of each is for the good of all is stronger than ever. It is not expressly formulated, but it exists everywhere in practice. Men work less and less for their individual interests, and more and more for the good of the community. The woodsman who fells a tree in a Western forest has no thought of using its wood for himself. He neither knows nor cares what may become of it. But he knows that in one region a farmer is raising grain, and in another an artisan is weaving cloth, and that some of these will come to him in exchange for his labor. And between woodsman, farmer, and artisan, are fifty or five hundred other individuals, each of whom takes some part in this exchange of products. Neither of these parties works directly for himself, yet each works for the good of all in a far higher and more developed sense than in the analogous case of the communal insects.

It is necessary now to return to another phase of the subject here considered, that relating to the intellectual development of animals. It has often been a source of wonder that the ants and bees have advanced so far in intellectual achievement beyond all other members of the insect class, and that many of their habits and institutions so closely simulate those of human society. This latter, indeed, is but another evidence of the law above considered, that all evolution, whether physical or mental, is controlled by one general principle, and must follow one naturally determined course. But the superior intellectuality of these low forms of life is in itself a phenomenon that calls for some special attention.

A glance at the situation at once reveals that this superiority of intellectual progress must in some way be connected with the communal stage of association, since it is manifested only by the communal animals, the ants, bees, termites, and beavers, and is not shown in any of the solitary species of these zoölogical groups. Evidence pointing in the same direction may be found in the habits of the social animals, which seem to have reasoned out the expedient of stationing sentries to guard them against danger while feeding. And it is interesting in this connection to perceive that the elephants, the most advanced of the herbivora in social combination, likewise display the greatest intellectual advancement.

We might deduce from these facts either the conclusion that intellectual development is favored by close association and communalism, or the reverse conclusion that an original superior intellectuality was the inciting cause of communal association. A consideration of all the facts of the case seems to prove that the former conclusion is the correct one. For observation indicates that individually the communal insects are not superior in intellect to the solitary species. Take the ant beyond the range of his hereditary instincts, and he seems a duller creature than the spider. The same conclusion applies to the beaver, which is said to be much duller, so far as individual powers of intellect

are concerned, than many other vertebrates. In fact, in Romanes's work on "Animal Intelligence," the highest powers of intellect are ascribed to the carnivora, which as a general rule are solitary animals. And this is a natural result of the fact that they are obliged to depend upon their own powers in all the exigencies of life, and can not trust to others to relieve them from some of the duties of existence.

Much has been said about the highly remarkable powers of the minute mass of nerve-substance in an ant's head. Yet the brain of every animal has undoubtedly a double duty to perform. It is partly devoted to the control of the muscular organization, partly to psychical activity. And to this we must ascribe the increase in size of brain that generally attends increase in size of body among animals. Though the brain of a large animal may be much larger than that of a small one, this may be mainly due to the increase of its motor duties, and there may be no increase in its psychical portion. In fact, in certain large extinct animals, with greatly developed posterior structure, a sort of second brain seems to have existed at the rear extremity of the spinal column, as if the motor portion of the brain had moved backward to the region where it was most needed. Yet it is very probable that in any of the higher vertebrates the portion of the brain devoted to psychical functions is considerably greater in volume than the whole brain of the ant. And, if the degree of intelligence be in any sense proportional to the size of its organ, these higher vertebrates should be superior in intellect to the ant.

Such is actually the case. The excursions of the ant-mind beyond the limit of its instincts seem to be exceedingly slight. Those of the mammalian mind are sometimes extensive. If we compare the instances of individual intellect displayed by a cat and an ant, for instance, we can not avoid the conclusion that the cat is very greatly superior in powers of reasoning. Yet no cat tribes keep cows, marshal armies, store provisions, enslave captives, or perform any of the wonderful series of intellectual acts which are common in ant communities, and which form part of the powers of every ant-brain. How shall we account for this difference in results? It seems evident that it is in some way due to difference in modes of association. The powers of the ant are instinctive—that is, they have been passed down by hereditary transmission through numerous generations. They are the outcome of not one brain, but of innumerable brains. Though the brain of one ant be minute, yet the brains of a million ants would form a considerable mass, and every act of ant intellect is probably the product of several millions of ant-brains, each of which may have added some minute increment to the final result.

There are, in fact, two distinct methods by which the intellectual powers of ancestors may be transmitted to descendants. One of these is the hereditary, the other the experimental. Among solitary animals the special intellectual achievements of each animal are in great meas-

ure lost. They are unseen by others, and the experience of each dies with it. For, as we well know, it is only the general, not the special powers of the mind that are transmitted by heredity. No child is born with the special knowledge of its parents, though it may possess all the intellectual tendencies and powers of its parents. Only when some action is repeated generation after generation does it produce so strong an impress upon the intellect as to be hereditarily transmitted. In this case we have the inheritance of an instinct, or strong special mental tendency.

It is evident that among social animals acts of special shrewdness performed by any individual are likely to be seen and may be imitated by others. In such cases an educational is added to the hereditary method of intellectual transmission. Any such acts, if of special value to the community, may be very frequently repeated, and if the community be long kept together it may make important steps of progress in this method alone. When, again, communities pass from the social to the communal phase of association the influence above mentioned must act with much greater vigor. For the members of communal are much more closely associated than those of social groups. They work more together, and are brought into more intimate association in all the details of life. It is claimed by some writers that the young actually go to school to the old, and are specially taught the duties of the hive and the ant-hill.* In addition to this there is much reason to believe that the communities of communal animals are often continuous for a very long period of time. The ant city does not die out with one generation, but may continue in existence through an indefinite number of generations. The bee family sends out its annual swarms, but the young before this migration are old enough to have been taught all the duties of bee-life. Thus the special habits of a single original hive may be transmitted, in the educational method, to an indefinite number of much later hives. Parallel conditions are known to exist among the beavers. The condition is similar to that of an overcrowded human community, whose younger members migrate in search of a new home, but not until they have learned all the arts of the parental community.

Communalism, therefore, has its special value as an aid to the transmission of knowledge and useful habits through teaching and observa-

* Romanes says that the "house-bees" are the younger bees left at home, for domestic duties, with only a small proportion of older ones, left probably to direct the young. The young ant "is led about the nest, and trained to a knowledge of domestic duties, especially in the case of larvæ. Later on the young ants are taught to distinguish between friends and foes. When an ant-nest is attacked by foreign ants the young ants never join in the fight, but confine themselves to removing the pupæ." In a nest made by Forel of young ants and pupæ of different species, no hostility arose. They dwelt together as a happy family. They had not been educated into hostility to foreigners. Lubbock says, "It is remarkable how much individual ants appear to differ from one another in character." There is thus a natural basis for the development of new habits.

tion. It also induces the incessant reiteration of acts that have proved beneficial to the community, until the tendency to perform these acts becomes so strong that it is hereditarily transmitted. In other words, it tends to produce instincts. In fact, in the case of animals of low intellectual vigor, like the ants and bees, it seems probable that new habits, of special value to a community, grow up only by minute increments, and through long periods of time. Each when gained becomes repeated through innumerable generations, and finally becomes an instinct, capable of hereditary transmission. In this way animals of very slight intellectual vigor, by the educational transmission of all beneficial individual acts, may have gradually gained the diversified mental conditions of these two remarkable types.

In ant and bee communities, as at present constituted, the hereditary transmission of new arts seems at first sight impossible. Intellectual acts performed by the workers must remain unknown to the solitary female, who can only transmit the ancient instincts. It would seem as if the development of communalism had reached a point at which intellectual progress must stop. The general habits of ants and bees were probably gained during their slow evolution of communalism from socialism, and ere the sexual relations had attained their present extreme restriction. With but one female, who takes no part in the duties of home or field, and remains ignorant of any shrewd act that may be performed by a worker, it seems impossible that the existing instincts should receive any addition.

Yet this is not quite impossible, even in the present conditions of ant and bee life. Experiential development and transmission of new habits may continue indefinitely, since single communities may continue in existence, or may yield direct colonies, for indefinite periods of years. And the occasional birth of males from workers affords a possible means by which these habits may be hereditarily transmitted, since it is quite conceivable that these male children of workers may become the parents of new communities. In bee communities the occasional transformation of a worker into a queen affords a direct means for the transmission of worker characteristics. The case is closely parallel to that of the transmission of knowledge in human communities, though in the latter hereditary transmission is of limited scope, and education is the great agent in the communication of knowledge.

Special attention has here been given to this question, as it is one that has excited much comment and debate, and the thoughts here advanced may not be without their interest and value. I would but repeat what is above said, that the remarkable institutions of ant and bee communities do not indicate any intellectual superiority to solitary animals in the members of these communities, but simply a much superior method for the transmission of intellectual results. And to this may be added the final conclusion that while ant and bee communalism has now reached a stage that must tend in great measure to check the

hereditary transmission of new habits, yet it is possible that a slow improvement in the habits of these communities may still continue, both by education or observation and by heredity.

The mental relations of animal communities, as thus reviewed, apply closely to the question of the intellectual development of man. Among the quadrumana socialism is often greatly developed, educational transmission is common, and much intellectual shrewdness is manifested. But, between the intellectuality of these communities and those of the ants and bees, there is a marked difference. We speak of the monkey as marked by incessant curiosity. That is to say, he makes constant mental excursions beyond the range of his hereditary habits. He constantly "wants to know." His intellectual acumen is far superior to that of the low animal tribes, which have advanced so far beyond him in habits. In man the same "want to know" has ever been active, and to it are due his rapid gaining of new experiences and increase in knowledge. Yet, so far as social organization is concerned, he was very long in reaching the level attained by the communal animals. He probably continued for ages in the social state, though it is impossible to say how early the patriarchal state may have been reached. Three or four thousand years ago we find the ancestors of the present civilized nations everywhere organized under conditions closely analogous to those of ant and bee communities, though in their mental acumen and variety of habits and knowledge they were almost infinitely superior.

With one further consideration we may close. It is of interest to perceive that in human communities the transmission of intellectual habits is mainly and almost entirely a consequence of education, either direct or indirect. Instinct is almost non-existent, so far as the industrial and intellectual habits of life are concerned. We might destroy an ant city, with the exception of a single male and female, yet these would give rise to a new city, with no perceptible difference in powers from the old. Yet were we to destroy a civilized human community, with the exception of a few infants, these, could they give rise to descendants, in isolated localities, would yield a community nearly destitute of knowledge and of the power of dealing with Nature. They would have to begin anew, where their ancestors began ages before. Yet they would possess mental powers and tendencies that would enable them to rapidly gain new experience and habits, and would undoubtedly develop into a new civilization with exceedingly greater rapidity than was shown in the development of primeval man.

It is the rapidity of progress in human habits and knowledge that prevents any of these habits becoming instinctive. Old conditions are rapidly thrown aside and new ones gained, and no method of action is pursued long enough for it to grow into the force of an instinct. The tendency of human progress is to check instinct, and to more and more constantly employ reason, while with the lower animals the tendency

is to the development of instincts. And we may close by naming the ants and bees as instances of the extreme unfoldment of the instinctive powers, man as an instance of the greatest checking of instinct and development of the reasoning faculties.

FISH OUT OF WATER.

By GRANT ALLEN.

STROLLING one day in what is euphemistically termed, in equatorial latitudes, "the cool of the evening," along a tangled tropical American field-path, through a low region of lagoons and watercourses, my attention happened to be momentarily attracted from the monotonous pursuit of the nimble mosquito by a small animal scuttling along irregularly before me, as if in a great hurry to get out of my way before I could turn him into an excellent specimen. At first sight I took the little hopper, in the gray dusk, for one of the common, small green lizards, and wasn't much disposed to pay it any distinguished share either of personal or scientific attention. But, as I walked on a little farther through the dense underbrush, more and more of these shuffling and scurrying little creatures kept crossing the path, hastily, all in one direction, and all, as it were, in a formed body or marching phalanx. Looking closer, to my great surprise I found they were actually fish out of water, going on a walking-tour, for change of air, to a new residence—genuine fish, a couple of inches long each, not eel-shaped or serpentine in outline, but closely resembling a red mullet in miniature, though much more beautifully and delicately colored, and with fins and tails of the most orthodox spiny and prickly description. They were traveling across-country in a bee-line, thousands of them together, not at all like the helpless fish out of water of popular imagination, but as unconcernedly and naturally as if they had been accustomed to the overland route for their whole lifetimes, and were walking now on the king's highway without let or hindrance.

I took one up in my hand and examined it more carefully; though the catching it wasn't by any means so easy as it sounds on paper, for these perambulatory fish are thoroughly inured to the dangers and difficulties of dry land, and can get out of your way when you try to capture them with a rapidity and dexterity which are truly surprising. The little creatures are very pretty, well-formed cat-fish, with bright, intelligent eyes, and a body armed all over, like the armadillo's, with a continuous coat of hard and horny mail. This coat is not formed of scales, as in most fish, but of toughened skin, as in crocodiles and alligators, arranged in two overlapping rows of imbricated shields, ex-

actly like the round tiles so common on the roofs of Italian cottages. The fish walks, or rather shambles along ungracefully, by the shuffling movement of a pair of stiff spines placed close behind his head, aided by the steering action of his tail, and a constant snake-like wriggling motion of his entire body. Leg-spines of somewhat the same sort are found in the common English gurnard, and, in this age of aquariums and fisheries exhibitions, most adult persons above the age of twenty-one years must have observed the gurnards themselves crawling along suspiciously by their aid at the bottom of a tank at the Crystal Palace or the polyonymous South Kensington building. But, while the European gurnard only uses his substitutes for legs on the bed of the ocean, my itinerant tropical acquaintance (his name, I regret to say, is Callichthys) uses them boldly for terrestrial locomotion across the dry lowlands of his native country. And, while the gurnard has no less than six of these pro-legs, the American land-fish has only a single pair with which to accomplish his arduous journeys. If this be considered as a point of inferiority in the armor-plated American species, we must remember that while beetles and grasshoppers have as many as six legs apiece, man, the head and crown of things, is content to scramble through life ungracefully with no more than two.

There are a great many tropical American pond-fish which share these adventurous gypsy habits of the pretty little Callichthys. Though they belong to two distinct groups, otherwise unconnected, the circumstances of the country they inhabit have induced in both families this queer fashion of waddling out courageously on dry land, and going on voyages of exploration in search of fresh ponds and shallows new, somewhere in the neighborhood of their late residence. One kind in particular, the Brazilian Doras, takes land-journeys of such surprising length that he often spends several nights on the way, and the Indians who meet the wandering bands during their migrations fill several baskets full of the prey thus dropped upon them, as it were, from the kindly clouds.

Both Doras and Callichthys, too, are well provided with means of defense against the enemies they may chance to meet during their terrestrial excursions; for in both kinds there are the same bony shields along the sides, securing the little travelers, as far as possible, from attack on the part of hungry piscivorous animals. Doras further utilizes its powers of living out of water by going ashore to fetch dry leaves, with which it builds itself a regular nest, like a bird's, at the beginning of the rainy season. In this nest the affectionate parents carefully cover up their eggs, the hope of the race, and watch over them with the utmost attention. Many other fish build nests in the water, of materials naturally found at the bottom; but Doras, I believe, is the only one that builds them on the beach, of materials sought for on the dry land.

Such amphibious habits on the part of certain tropical fish are easy

enough to explain by the fashionable clew of "adaptation to environment." Ponds are always very likely to dry up, and so the animals that frequent ponds are usually capable of bearing a very long deprivation of water. Indeed, our evolutionists generally hold that land-animals have in every case sprung from pond-animals which have gradually adapted themselves to do without water altogether. Life, according to this theory, began in the ocean, spread up the estuaries into the greater rivers, thence extended to the brooks and lakes, and finally migrated to the ponds, puddles, swamps, and marshes, whence it took at last, by tentative degrees, to the solid shore, the plains, and the mountains. Certainly the tenacity of life shown by pond-animals is very remarkable. Our own English carp bury themselves deeply in the mud in winter, and there remain in a dormant condition many months entirely without food. During this long hibernating period, they can be preserved alive for a considerable time out of water, especially if their gills are, from time to time, slightly moistened. They may then be sent to any address by parcels-post, packed in wet moss, without serious damage to their constitution; though, according to Dr. Günther, these dissipated products of civilization prefer to have a piece of bread steeped in brandy put into their mouths to sustain them beforehand. In Holland, where the carp are not so sophisticated, they are often kept the whole winter through, hung up in a net to keep them from freezing. At first they require to be slightly wetted from time to time, just to acclimatize them gradually to so dry an existence; but after a while they adapt themselves cheerfully to their altered circumstances, and feed on an occasional frugal meal of bread and milk with Christian resignation.

Of all land-frequenting fish, however, by far the most famous is the so-called climbing-perch of India, which not only walks bodily out of the water, but even climbs trees by means of special spines, near the head and tail, so arranged as to stick into the bark and enable it to wriggle its way up awkwardly, something after the same fashion as the "looping" of caterpillars. The tree-climber is a small, scaly fish, seldom more than seven inches long; but it has developed a special breathing apparatus to enable it to keep up the stock of oxygen on its terrestrial excursions, which may be regarded as to some extent the exact converse of the means employed by divers to supply themselves with air under water. Just above the gills, which form of course its natural hereditary breathing apparatus, the climbing-perch has invented a new and wholly original water-chamber, containing within it a frilled bony organ, which enables it to extract oxygen from the stored-up water during the course of its aërial peregrinations. While on shore it picks up small insects, worms, and grubs; but it also has vegetarian tastes of its own, and does not despise fruits and berries. The Indian jugglers tame the climbing-perches and carry them about with them as part of their stock in trade; their ability to

live for a long time out of water makes them useful confederates in many small tricks which seem very wonderful to people accustomed to believe that fish die almost at once when taken out of their native element.

The Indian snakehead is a closely allied species, common in the shallow ponds and fresh-water tanks of India, where holy Brahmans bathe and drink and die and are buried, and most of which dry up entirely during the dry season. The snakehead, therefore, has similarly accommodated himself to this annual peculiarity in his local habitation by acquiring a special chamber for retaining water to moisten his gills throughout his long deprivation of that prime necessary. He lives composedly in semi-fluid mud, or lies torpid in the hard-baked clay at the bottom of the dry tank from which all the water has utterly evaporated in the drought of summer. As long as the mud remains soft enough to allow the fish to rise slowly through it, they come to the surface every now and then to take in a good hearty gulp of air, exactly as gold-fish do in England when confined with thoughtless or ignorant cruelty in a glass globe too small to provide sufficient oxygen for their respiration. But when the mud hardens entirely they hibernate, or rather æstivate, in a dormant condition until the bursting of the monsoon fills the ponds once more with the welcome water. Even in the perfectly dry state, however, they probably manage to get a little air every now and again through the numerous chinks and fissures in the sun-baked mud. Our Aryan brother then goes a-fishing playfully with a spade and bucket, and digs the snakehead in this mean fashion out of his comfortable lair with an ultimate view to the manufacture of pillau. In Burmah, indeed, while the mud is still soft the ingenious Burmese catch the helpless creatures by a still meaner and more unsportsmanlike device. They spread a large cloth over the slimy ooze where the snakeheads lie buried, and so cut off entirely for the moment their supply of oxygen. The poor fish, half-asphyxiated by this unkind treatment, come up gasping to the surface under the cloth in search of fresh air, and are then easily caught with the hand and tossed into baskets by the degenerate Buddhists.

Old Anglo-Indians even say that some of these mud-haunting Oriental fish will survive for many years in a state of suspended animation, and that, when ponds or *jhils* which are known to have been dry for several successive seasons are suddenly filled by heavy rains, they are found to be swarming at once with full-grown snakeheads, released in a moment from what I may venture to call their living tomb in the hardened bottom. Whether such statements are absolutely true or not the present deponent would be loath to decide dogmatically; but, if we were implicitly to swallow everything that the old Anglo-Indian in his simplicity assures us he has seen—well, the clergy would have no further cause any longer to deplore the growing skepticism and unbelief of these latter unfaithful ages.

This habit of lying in the mud and there becoming torpid may be looked upon as a natural alternative to the habit of migrating across-country, when your pond dries up, in search of larger and more permanent sheets of water. Some fish solve the problem how to get through the dry season in one of these two alternative fashions, and some in the other. In flat countries where small ponds and tanks alone exist, the burying plan is almost universal; in plains traversed by large rivers or containing considerable scattered lakes, the migratory system finds greater favor with the piscine population.

One tropical species which adopts the tactics of hiding itself in the hard clay, the African mud-fish, is specially interesting to us human beings on two accounts: first, because, unlike almost all other kinds of fish, it possesses lungs as well as gills; and, secondly, because it forms an intermediate link between the true fish and the frogs or amphibians, and therefore stands in all probability in the direct line of human descent, being the living representative of one among our own remote and early ancestors. Scientific interest and filial piety ought alike to secure our attention for the African mud-fish. It lives its amphibious life among the rice-fields on the Nile, the Zambesi, and the Gambia, and is so greatly given to a terrestrial existence that its swim-bladder has become porous and cellular, so as to be modified into a pair of true and serviceable lungs. In fact, the lungs themselves in all the higher animals are merely the swim-bladders of fish, slightly altered so as to perform a new but closely allied office. The mud-fish is common enough in all the larger English aquariums, owing to a convenient habit in which it indulges, and which permits it to be readily conveyed to all parts of the globe on the same principle as the vans for furniture. When the dry season comes on and the rice-fields are reduced to banks of baking mud, the mud-fish retire to the bottom of their pools, where they form for themselves a sort of cocoon of hardened clay, lined with mucus, and with a hole at each end to admit the air; and in this snug retreat they remain torpid till the return of wet weather. As the fish usually reach a length of three or four feet, the cocoons are of course by no means easy to transport entire. Nevertheless, the natives manage to dig them up whole, fish and all; and, if the capsules are not broken, the unconscious inmates can be sent across by steamer to Europe with perfect safety. Their astonishment when they finally wake up after their long slumber, and find themselves inspecting the British public, as introduced to them by Mr. Farini, through a sheet of plate-glass, must be profound and interesting.

In England itself, on the other hand, we have at least one kind of fish which exemplifies the opposite or migratory solution of the dry-pond problem, and that is our familiar friend the common eel. The ways of eels are indeed mysterious, for nobody has ever yet succeeded in discovering where, when, or how they manage to spawn; nobody has ever yet seen an eel's egg, or caught a female eel in the spawning

condition, or even observed a really adult male or female specimen of perfect development. All the eels ever found in fresh water are immature and undeveloped creatures. But eels do certainly spawn somewhere or other in the deep sea, and every year, in the course of the summer, flocks of young ones, known as elvers, ascend the rivers in enormous quantities, like a vast army under numberless leaders. At each tributary or affluent, be it river, brook, stream, or ditch, a proportionate detachment of the main body is given off to explore the various branches, while the central force wriggles its way up the chief channel, regardless of obstacles, with undiminished vigor. When the young elvers come to a weir, a wall, a flood-gate, or a lasher, they simply squirm their way up the perpendicular barrier with indescribable wrigglings, as if they were wholly unacquainted, physically as well as mentally, with Newton's magnificent discovery of gravitation. Nothing stops them; they go wherever water is to be found; and, though millions perish hopelessly in the attempt, millions more survive in the end to attain their goal in the upper reaches. They even seem to scent ponds or lakes mysteriously, at a distance, and will strike boldly straight across-country, to sheets of water wholly cut off from communication with the river which forms their chief highway.

The full-grown eels are also given to journeying across-country in a more sober, sedate, and dignified manner, as becomes fish which have fully arrived at years, or rather months, of discretion. When the ponds in which they live dry up in summer, they make in a bee-line for the nearest sheet of fresh water, whose direction and distance they appear to know intuitively, through some strange instinctive geographical faculty. On their way across-country they do not despise the succulent rat, whom they swallow whole, when caught, with great gusto. To keep their gills wet during these excursions, eels have the power of distending the skin on each side of the neck, just below the head, so as to form a big pouch or swelling. This pouch they fill with water, to carry a good supply along with them until they reach the ponds for which they are making. It is the pouch alone that enables eels to live so long out of water under all circumstances, and so incidentally exposes them to the disagreeable experience of getting skinned alive, which, it is to be feared, still forms the fate of most of those that fall into the clutches of the human species.

A far more singular walking fish than any of these is the odd creature that rejoices (unfortunately) in the very classical surname of Periophthalmus, which is, being interpreted, Stare-about. (If he had a recognized English name of his own, I would gladly give it; but, as he hasn't, and as it is clearly necessary to call him something, I fear we must stick to the somewhat alarming scientific nomenclature.) Periophthalmus, then, is an odd fish of the tropical Pacific shores, with a pair of very distinct fore-legs (theoretically described as modified pectoral fins), and with two goggle-eyes, which he can protrude at

pleasure right outside the sockets, so as to look in whatever direction he chooses, without even taking the trouble to turn his head to left or right, backward or forward. At ebb-tide this singular peripatetic goby literally walks straight out of the water, and promenades the bare beach erect on two legs in search of small crabs and other stray marine animals left behind by the receding waters. If you try to catch him, he hops away briskly much like a frog, and stares back at you grimly over his left shoulder with his squinting optics. So completely adapted is he for this amphibious 'longshore existence that his big eyes, unlike those of most other fish, are formed for seeing in the air as well as in the water. Nothing can be more ludicrous than to watch him suddenly thrusting these very movable orbs right out of their sockets like a pair of telescopes, and twisting them round in all directions so as to see in front, behind, on top, and below, in one delightful circular sweep.

There is also a certain curious tropical American carp, which, though it hardly deserves to be considered in the strictest sense as a fish out of water, yet manages to fall nearly half-way under that peculiar category, for it always swims with its head partly above the surface and partly below. But the funniest thing in this queer arrangement is the fact that one half of each eye is out in the air and the other half is beneath in the water. Accordingly, the eye is divided horizontally by a dark strip into two distinct and unlike portions, the upper one of which has a pupil adapted to vision in the air alone, while the lower is adapted to seeing in the water only. The fish, in fact, always swims with its eye half out of the water, and it can see as well on dry land as in its native ocean. Its name is Anableps, but, in all probability, it does not wish the fact to be generally known.

The flying-fish are fish out of water in a somewhat different and more transitory sense. Their aërial excursions are brief and rapid; they can only fly a very little way, and have soon to take once more for safety to their own more natural and permanent element. More than forty kinds of the family are known, in appearance very much like English herrings, but with the front fins expanded and modified into veritable wings. It is fashionable nowadays among naturalists to assert that the flying-fish don't fly; that they merely jump horizontally out of the water with a powerful impulse, and fall again as soon as the force of the first impetus is entirely spent. When men endeavor to persuade you to such folly, believe them not. For my own part, I have seen the flying-fish fly—deliberately fly, and flutter, and rise again, and change the direction of their flight in mid-air, exactly after the fashion of a big dragon-fly. If the other people who have watched them haven't succeeded in seeing them fly, that is their own fault, or, at least, their own misfortune; perhaps their eyes weren't quick enough to catch the rapid, though to me perfectly recognizable, hovering and fluttering of the gauze-like wings; but I have

seen them myself, and I maintain that on such a question one piece of positive evidence is a great deal better than a hundred negative. The testimony of all the witnesses who didn't see the murder committed is as nothing compared with the single testimony of the one man who really did see it. And in this case I have met with many other quick observers who fully agreed with me against the weight of scientific opinion, that they have seen the flying-fish really fly with their own eyes, and no mistake about it. The German professors, indeed, all think otherwise; but then the German professors all wear green spectacles, which are the outward and visible sign of "blinded eyesight poring over miserable books." The unsophisticated vision of the noble British seaman is unanimously with me on the matter of the reality of the fishes' flight.

Another group of very interesting fish out of water are the flying gurnards, common enough in the Mediterranean and the tropical Atlantic. They are much heavier and bigger creatures than the true flying-fish of the herring type, being often a foot and a half long, and their wings are much larger in proportion, though not, I think, really so powerful as those of their pretty little silvery rivals. All flying-fish fly only of necessity, not from choice. They leave the water when pursued by their enemies, or when frightened by the rapid approach of a big steamer. So swiftly do they fly, however, that they can far outstrip a ship going at the rate of ten knots an hour; and I have often watched one keep ahead of a great Pacific liner under full steam for many minutes together in quick, successive flights of three or four hundred feet each. Oddly enough, they can fly farther against the wind than before it—a fact acknowledged even by the spectacled Germans themselves, and very hard indeed to reconcile with the orthodox belief that they are not flying at all, but only jumping. I don't know whether the flying gurnards are good eating or not; but the silvery flying-fish are caught for market (sad desecration of the poetry of Nature!) in the Windward Islands, and, when nicely fried in egg and bread-crumb, are really quite as good, for practical purposes, as smelts or whiting, or any other prosaic European substitute.

On the whole, it will be clear, I think, to the impartial reader, from this rapid survey, that the helplessness and awkwardness of a fish out of water have been much exaggerated by the thoughtless generalization of unscientific humanity. Granting, for argument's sake, that most fish prefer the water, as a matter of abstract predilection, to the dry land, it must be admitted *per contra* that many fish cut a much better figure on *terra firma* than most of their critics themselves would cut in mid-ocean. There are fish that wriggle across-country intrepidly with the dexterity and agility of the most accomplished snakes; there are fish that walk about on open sand-banks, semi-erect on two legs, as easily as lizards; there are fish that hop and skip on tail and fins in a manner that the celebrated jumping-frog

himself might have observed with envy; and there are fish that fly through the air of heaven with a grace and swiftness that would put to shame innumerable species among their feathered competitors. Nay, there are even fish, like some kinds of eels and the African mud-fish, that scarcely live in the water at all, but merely frequent wet and marshy places, where they lie snugly in the soft ooze and damp earth that line the bottom. If I have only succeeded, therefore, in relieving the mind of one sensitive and retiring fish from the absurd obloquy cast upon its appearance when it ventures away for a while from its proper element, then, in the pathetic and prophetic words borrowed from a thousand uncut prefaces, this work will not, I trust, have been written in vain.—*Cornhill Magazine.*

THE FLOWER OR THE LEAF.

By Dr. MARY PUTNAM-JACOBI.

"Quod she agen, 'But to whom do ye owe
Your service? and which wolle ye honour,
Tel me I pray, this yere, the Leaf or the Flower?'"
CHAUCER, "The Flower and the Leaf."

THE comments made by Miss Youmans,* upon a single remark in my article on "Primary Education," show how much can be unfolded out of an apparently limited subject, when all its bearings are thoroughly discussed. Already this discussion trenches upon several philosophical principles which involve much more than the apparently trivial question whether children should begin the study of botany by the flower or the leaf. An inquiry into these principles may therefore be not uninteresting.

Miss Youmans lays down certain propositions, with some of which I do in reality agree, while with others I am in decided disagreement, for reasons I will take the liberty of here setting forth. Thus:

1. Children should study the external characters of plants before attempting to study their life-processes or physiology.

2. Children can not be suitably impressed with such "tremendous ideas as evolution," and therefore it is useless to signalize these to them.

3. Children should not be detained to draw the leaves or other natural objects they study, because of "the delay" thus entailed, and because "they could not draw one in a hundred of the specimens with which it is necessary that they become familiar."

4. The modern systems of botanical classification are based on the sum total of the characters of the plant, and not on the corolla. It is therefore unphilosophical to study the flower containing the corolla

* "Popular Science Monthly," October, 1885.

first, merely because it is more showy. The sensuous pleasure derived from its contemplation is superficial as compared with the deeper intellectual pleasure of tracing the scientific relations of the leaf.

5. Finally, it is an axiom that can not be disputed, that mental effort should advance from the simple subject to the more complex. The leaf is much simpler than the flower, and is therefore much better suited for beginning the study of botany.

To consider these propositions in order: 1 and 2. In regard to the first I am substantially in entire agreement with Miss Youmans, as indeed is shown by the examples given in the "Experiment." No attempt was made to really study the physiology of plants; while the external and obvious characters of the most conspicuous portions, the parts, namely, of the flower, were studied, or rather submitted to a prolonged contemplation. Only, upon first crossing the threshold of this new world, the most characteristic facts which distinguished it were pointed out in a manner designed to make as profound an impression as possible upon the imagination. These are the facts of life and growth and death, the germination of the seed, the influence of surrounding media, the circumstance that the plant offers a constant succession of changing phenomena, and thus was an entirely different object from a stone, or a mathematical figure, or a rainbow. Now, while it is perfectly true that the term "evolution" and the vast series of ideas and masses of facts suggested by it can not be rendered comprehensible to a child, and that it would be the grossest pedantry to even mention it to him, yet the great fact of growth and incessant change in living organisms is perfectly appreciable through impressions made on his senses, and is well fitted to arouse in him a lively interest and curiosity. The fact of life—the essential nature of life as a series of incessant changes—is perhaps the most fundamental fact with which the mind will ever become acquainted. It is also among the most primitive and earliest encountered; the mode of impression it makes upon the mind permanently stamps all the thoughts and systems of thought the mind ever entertains. For, whence spring all religions, and cosmogonies, and even ethical systems, but from the primitive thoughts held upon life and death? How many immoralities depend upon false estimates of life, of its nature, its values! How many erroneous theories of life might be corrected by the early habit of direct, unbiased observation of living things! In the building of a brain, the earliest ideas always remain the most powerful, because upon them the entire mental structure is destined to repose; or, since the mind is a living organism, it were better to compare its primitive ideas, not to the foundation-stones of a house, but to the central medullary rings of a tree. What is on the surface while the plant is young soon becomes central by the successive superposition of new impressions, the new circles being constantly intersected by rays prolonged from the central pith. The selection of the earliest ideas and impressions is therefore of the

highest importance; they should be not only negatively good, that is, innocent, but, when possible, really powerful, that is, brought from the depths of things, and able to sustain all the future life of the mind possessing them. And, since direct perception of facts must precede reasoning upon the inferences which may be drawn from them, it is not only legitimate but important to impress the imagination with typical and fundamental facts, long before these can be reasoned upon, or their laws really understood. This is my lengthy reason for the simple experiment of studying the growth of beans on a saucer of cotton-wool—experiment designed not to teach physiology, but to make an early revelation of life.

In this connection, however, is worth noting a special reason for preferring the flower to the leaf for early study. It is agreed that the functions of living organisms are too difficult for such study; nevertheless, it is desirable to *indicate* functions when possible, because the fact of function is one eminently characteristic of living things. Now, the function of the leaf is respiration, which can not possibly be made intelligible to the child. It involves chemical relations, which are the latest appreciable, and can not be exhibited except by means of experiments, for which the young child is quite unprepared. The absence of the visible phenomena of animal respiration, moreover, that is of the exhalation of the breath and movements of the thorax, render an attempt to identify the function in plants and animals confusing and apparently contradictory.

On the other hand, the function of the flower—reproduction—can be rendered perfectly intelligible to the child, when he is told that the pollen feeds the ovules, which then visibly grow into seeds, while the ovary ripens to fruit. This statement seems to the child in accordance with his own most urgent personal necessities, and in the common facts of feeding and growth he finds himself linked with other organisms in Nature. It is quite congenial to the normal fetichism of a young child's mind to regard plants as animals; and legends of dryads are as natural to him as to the infancy of the human race.

But the assimilation of animals to plants through the molecular processes of nutrition common to both (though perhaps unconsciously foreshadowed in the story of Narcissus) was not for mankind distinctly formulated until the time of Bichat; and, for the individual intelligence, its comprehension must be deferred until nearly to adolescence.

3. I must plead guilty to an inaccuracy when, quoting from memory, I said that Miss Youmans recommended her pupils to *draw* the leaves that they studied. But I fell into the error all the more readily, because such a direction entirely commended itself to my own judgment. Nor can I agree at all with the reasons which Miss Youmans now advances in opposition to this method. If the aim at the time be not to learn botany, but "to cultivate the observing powers

of children," what danger is there in a "delay" which permits the object to become more deeply graven on the child's mind? Why is it so "necessary to become familiar with hundreds of specimens" in a given time? Why not rather with a few, a very few striking and typical forms, around which subsequent knowledge can group itself? The comparison of a multitude of objects in order to abstract their common characters, and thus obtain the generic or class conception, is suited to the scientific but not to the pre-scientific stage of progress. It does not, therefore, belong to the fruitful moment of first attraction to an object, which, for the adult mind, precedes scientific discovery, and contains the hidden forces which lead to this. Still less does it belong to the first mental efforts of childhood. Early childhood is a period for the differentiation of the details of a universe, which, to the earliest perceptions, appears to consist entirely of homogeneous masses of light and shade. In the first efforts of the mind these masses are broken up and separated from one another, and portions reintegrated into actual individuals. Thus the moon is separated from the window-pane, the child's limbs are integrated into a body, which at last is positively known to be different from other moving forms, etc. It is in accordance with this spontaneous and, indeed, inevitable mode of development of perception that the first educated efforts of perception should be directed toward the more intense individualization of objects, and not to their classification; toward the thorough appreciation of specific differences rather than to that of generic resemblances. Hence, a second reason for beginning the study of botany—say, rather, the observation of life—with the flower, although more complex, and not with the simpler leaf. It is because the individual differences of the flower are so much more striking, and—as the poets show us—the flower is so much more readily individualized and personified.*

The period of development with which my "experiment" was concerned may be called the pre-scientific stage of mental existence. It is that during which the mind may be busily occupied in collecting the data for science, but can not itself wield scientific methods. Its efforts should be directed in accordance with scientific principles of psychology, and the knowledge acquired arranged in such orderly sequence that, when the mind is ripe for them, scientific relations will be readily perceived and understood. But discussion of such relations seems to me entirely premature for the age here considered, and, indeed, for a much later period.

Scientific observation is observation of the relations between things. But, before any attempt be made to study these relations, the things themselves should be firmly and clearly apprehended. The different degree of grasp possessed by different minds depends largely upon

* Trees, however, seem to have occasionally shared the poetic individualization. There is Emerson's "Pine-Tree," and "The Pine and the Palm" of Heine, not to speak of "The Fir-Tree" of Hans Andersen; and who could forget "The Talking Oak"?

differences in the degree of vividness and fervor with which they are impressed by individual objects, which leave so many persons in the most limp indifference, while exciting in others an absorbing and even passionate interest. When the individual impressions are so clear, distinct, characteristic, and interesting as to be quite unforgettable, they soon force upon the mind, after prolonged contemplation of them, suggestions of their multiple relations, and the knowledge which was at first simply picturesque becomes, sooner or later, scientific. The mental power which arrives at this is largely innate, and beyond the capacity of any education to bestow. But if any educational method can increase and develop it, it is that which most nearly imitates the spontaneous habits of fertile and original minds, apart from all systematic intention.

Three characters are conspicuous in the observation exercised by this class of minds: it is single, it is imaginative, and it is indefinitely prolonged. It is single—that is to say, the mind which is powerfully attracted to any object—and none ever discovers anything in any object to which it is not powerfully attracted, is in no haste to detach itself and pass on to anything new; on the contrary, it lingers and hates to go, and delays, and returns again and again to catch still another glimpse of what has been so delightful. To say that an object is suggestive is to say that it constantly opens up new trains of thought, and, so long as this is the case, the mind can not bear to abandon it. It is on this account that the contemplation is indefinitely prolonged, and irregularly so, according to no fixed rule or extrinsic necessity, not even that of mastering a certain quotum of information, but varies in accordance with the infinitely varied accidents of the mental intercourse. Finally, to be fruitful, this intercourse must be imaginative. First, in the lowest and most literal sense of the term, since the mind can not directly handle the sense-perception of the object, but only the mental image of the object, revived and remembered. But, in addition, to detect all its hidden meanings, properties, and possible aspects, many functions of the imagination must be brought into play, and none are useless. Fertility of fancy, rich association of ideas, are as important in collecting the premises for scientific argument as is the argument itself in the discovery of truth.*

During the pre-scientific period, therefore, either in the history of the race, the development of the individual, or the evolution of any single idea in an inquiring mind, the cardinal necessity is that of filling the mind with an abundance of distinct concepts and visual images of real concrete existences. Any prolonged attempt to compare, generalize, or reason about these should be deferred, under penalty of substituting a mere verbal imitation of reasoning for a real effort of the mind. A certain amount of reasoning and comparison will, of course,

* In these respects the mental history of the celebrated Faraday offers a mine of interesting facts and illustrations.

arise incidentally, but it must be kept subordinate to the main purpose. The soil must be enriched before it is plowed. Ideas must be clustered into dense and rich groups, individualities magnified and intensified, as, to keep to our subject, the flowers which are classified by the botanist may be individually magnified into almost conscious beings by the poet.*

* "A nun demure of lowly port,
Or sprightly maiden, of Love's court,
In thy simplicity the sport
Of all temptations;
A queen in crown of rubies drest,
A starveling in a scanty vest,
Are all, as seems to suit thee best,
Thy appellations."—WORDSWORTH, "To a Daisy."

"While the patient primrose sits
Like a beggar in the cold."—WORDSWORTH.

"Here are sweet-peas, on tiptoe for a flight
With wings of gentle flush o'er delicate white,
And taper fingers catching at all things
To bind them all about with tiny rings."—KEATS.

"Bloomy grapes, laughing from green attire."—Ibid.

"And the rose like a nymph to the bath addrest—
And the hyacinth's purple and white and blue,
Which flung from its bells a sweet peal anew
Of music, so delicate, soft, and intense,
It was felt like an odor within the sense."—SHELLEY.

"... daffodils,
That come before the swallow dares, and take
The winds of March with beauty; violets dim,
But sweeter than the lids of Juno's eyes
Or Cytherea's breath."—"Winter's Tale."

"Continuous as the stars that shine
And twinkle in the milky way; ...
Ten thousand saw I at a glance
Tossing their heads in sprightly dance."
—WORDSWORTH, "The Daffodils."

"Daisies, those pearled arcturi of the earth,
The constellated flower that never sets."—SHELLEY.

"The gold-eyed king-cups fine,
The frail blue-bell peereth over
Rare broidery of the purple clover."—TENNYSON.

"Open afresh your round of starry folds,
Ye ardent marigolds!"—KEATS.

"Death in the wood—
In the death-pale lips apart,
Death, in a whiteness that curdles the blood,
Now black to the very heart.
. . . . . .
To show that life by the spirit comes,
She gave us a soulless flower."
—ELAINE GOODALE, "The Indian Pipe."

Hence the suitableness of flowers for making large, forcible, indelible impressions on the imagination and the memory, and for storing the mind at the outset with the most vivid and beautiful conceptions of Nature.

The leaf offers, indeed, a variety of beautiful forms and outlines, which are not, however, either so numerous or so conspicuous as those displayed by the various organs of the flower. Leaves contrast less conspicuously with one another; their sensible differences are much less striking, and the eye of the child is not sufficiently trained to adequately appreciate the subtile differences of color which really exist. To him leaves can scarcely fail to present the vast monotony of green which the primitive vegetation of the earth is said to have exhibited before variegated corollas appeared. It is certainly desirable to repeat for the individual mind the experience of the race; but is it necessary for that to go back to the ages which antedated even the prehistoric man?

In a word, the differences of flowers resembles the "legend writ in large letters" which Plato advised should be first studied; the differences of leaves make the same legend repeated in the "small letters," and therefore more difficult to decipher.*

4. Miss Youmans's reason derived from botanical systems of classification I scarcely understand. It is very true that classification by the corolla is abandoned, and indeed never could have been carried very far. But the natural system, which sums up the total characters of the plant, certainly derives a much larger number of its data from the flower than from any other part of the plant. The great function of the plant is reproduction, and around the organs of reproduction contained in the flower center all its peculiarities. The mutual relations of stamens and pistils have been found inadequate for classification; but the extension of the class lines has still been chiefly in the direction of other parts of the flower, especially the fruit, ovule, and embryo.

Toward the flower converge all the forces of the plant; it is the culmination, the perfection of the entire vegetable organism. It should therefore be contemplated first, because, as it seems to me, it is eminently desirable that the child should, whenever possible, see the principal thing first; since whatever comes first is always liable to remain for him the most important. The habit of ranking things in the order of their real relative importance is certainly a most valuable habit to cultivate, both morally and intellectually. As has already been pointed out, the mind in its growth closely resembles that of a tree; for it, primary facts constantly tend to become central facts, and due organic proportions are only maintained between ideas when the principal, by being placed first, is enabled to become really central, a vitalized center of fitly organized knowledge. For

* "Republic," book ii, 368 (Jowett's translation).

all life develops from centers; and in Nature there are no single lines.

5. Miss Youmans's final proposition, that progress must always be made from the simple to the complex, is the one with which I do most decidedly disagree. The expression itself is ambiguous: for it may mean the transition from the easy to the difficult; or it may mean the study of elements as a preliminary to the study of the compounds into which they enter. In the latter meaning, the proposition can not surely be applied to the leaf and the flower. Morphologically speaking, it is true that all the parts of the flower result from transformations of the leaf, but this fact is altogether too recondite for a child's appreciation. In no other sense can the leaf be said to enter into the flower as an element—to be a "simpler" part of it. No knowledge to be gained of the flower, other than these facts of embryology, presupposes or requires knowledge of the leaf. Study of the one can only be said to prepare for the other by the degree of mental discipline it affords. And the very question at issue is, What is the best for mental discipline, the contemplation of objects with the fewer and less obvious characters, or of objects at once more conspicuous, and more abounding in interesting details? I have already stated the reasons which seem to me to justify the selection of the second method.

The first seems indorsed, and perhaps is intended to be so, by the Comtist classification of the sciences, and by the rather arbitrary attempt of its author to identify this with the actual order of their historic evolution. As regards their subject-matter, it would certainly be untrue to assert that this attracted the attention of mankind in the order of its (philosophically considered) simplicity.* At what appear to us to be the opening periods of Greek thought we find already coexisting the germs of all the six fundamental sciences, if we may assume that even chemistry was foreshadowed in the doctrines of the Four Elements. Such coexistence was inevitable, for the moment that the human mind was aroused enough to observe and theorize about anything, its attention could not fail to be attracted in several different directions simultaneously. It noticed the form and number of objects, and founded the sciences of geometry and arithmetic. But it was quite unaware that these sciences deal with simpler elements than make up human organisms, and believed that physiology and medicine

* "While he [Comte] asserts that the rational order of the sciences, like the order of their historic development, 'is determined by the degree of simplicity, or, what comes to the same thing, of generality of their phenomena,' it might, contrariwise, be asserted that, commencing with the complex and the special, mankind have progressed step by step to a knowledge of greater simplicity and wider generality."—SPENCER, "The Genesis of Science."

Mr. Spencer goes on to quote a remark of Whewell's that "the reader has already repeatedly seen in the course of this history complex and derivative principles [read 'objects'] presenting themselves to men's minds before simple and elementary ones."

are far simpler subjects, and far less involved in sublime mysteries, than are mathematics. All subjects were studied, or at least speculated upon, in no other order than that of their apparent nearness to human interests and that of the obviousness of their phenomena.*

Exactly the same is true for every individual mind, whose perceptions are not regularly successive, but simultaneous, and are as liable to be attracted toward infinitely complex objects as toward the simplest details. It is true, as has been pointed out in the "Experiment," that a child's first perceptions are necessarily of form and color, and the ideas of form belong to mathematics. But color is a physical property of bodies, and therefore the subject of a science which is, according to the Comtist measure of simplicity, two degrees removed from mathematics. On the other hand, the property of number, although like forms, mathematical, is not grasped till much after color and many other physical properties have been appreciated.

Other properties of bodies become known in direct proportion to their obviousness, and to their accidental impact on the senses, or to their association with the personal experience of the child. These may be mathematical, physical, biological, or even social. The mind of the child, like that of the race, looks over the surface of all things at once; its progress is not from the simple toward the complex, but from the superficial and obvious toward the profound and hidden. The mutual aid rendered by sciences, when, to use Herbert Spencer's expression, they become *arts* to one another, is only required after the observation and registration of accessible facts are completed, and when analysis is required to bring to light new facts or to explain others. But the child's mind does not reach this stage, and it is either illusory or fatal to attempt to force it prematurely.

It is very interesting to notice, by study of the actual evolution of knowledge, what a large amount of knowledge was obtained simultaneously in each department by independent observation, and before the necessity for mutual help, other than that derived from elementary mathematics, had been perceived. During this period the advance was made in each science, not by deductions from some simpler science, but by observations and methods peculiar to itself. Thus, as already stated, the germs of mathematics, physics, biology, and sociology, are all found coexisting at what seem to us the opening periods of Greek thought; nor was their degree of development at all proportioned to their degree of simplicity. If some truths of geometry and arithmetic were really established, so, in spite of the obscurity surrounding biological laws, were many phenomena of living beings also observed. The pulse was known, if the circulation was not, and numerous are the clinical observations of Hippocrates which still hold

* "The broad distinction between the two orders of knowledge [the ordinary and the scientific] is not in their nature, but in their remoteness from perception."—SPENCER, *loc. cit.*

good even in the scientific sphere of prognosis; and who could deny the permanent value of many of the ethical, political, and historical speculations of the ages of Plato, Thucydides, and Aristotle, even though, according to the Comtist doctrine, sociological speculations should have been valueless at this time, because entirely premature?*

The epoch of acquisition of facts, which must precede the discovery of their laws, often stretches over long periods of time—periods which interest us, because corresponding to the moment of education with which this discussion is concerned. The labors of the alchemists accumulated immense material on the composition of bodies and on their more recondite properties long before the scientific relations of chemistry could be established through the law of definite proportions. Physiology, the most complex of the physical sciences, has been most heterogeneous in the methods by which it has established its fundamental facts. The nature of respiration was, indeed, established by a chemist, from chemical data and from chemical experiments. But the nature of the circulation was partly inferred from anatomical facts—the presence of valves in veins—partly demonstrated by vivisection, a method of investigation which could not possibly be suggested by any other science than physiology. Knowledge of physics has materially assisted the interpretation of blood-pressure, of the expansion of the lungs, and many other phenomena, first known by direct observation of them. But the demonstration of the functions of the nervous system has been made exclusively by means of physiological experiment and clinical observation. "Science," observes Renan, "in order to formulate her laws, is obliged to make abstractions and to *create* simple circumstances, such as Nature never presents."† This is done usually with the aid of a simpler science, or one of wider generality, whose mastery thus becomes indispensable to further progress. But, until the moment for analysis and experiment has arrived, observation of the complex object is not more, but rather less difficult than that of the simple one, because in it so many varieties of details offer themselves spontaneously to the attention that the mind is at once fully occupied so soon as it begins to carefully observe; whereas pure observation soon exhausts the details of a simple object or phenomenon, and no further progress can be made until after a profound analysis has plunged below the surface. Let any one compare the rate of progress in the discovery of new knowledge in mathematics, astronomy, and even

* "What has often led linguists to regard the elementary monosyllabism of the Chinese as the primitive condition of all languages is the tendency which leads us to consider simplicity as indicating a state of infancy, or, at least, as the sign of a high antiquity. But this is an error. The Chinese language, though monosyllabic, has served a highly developed civilization; on the other hand, the languages of the savages of America, of Central and Southern Africa, offer a surprising richness of grammatical forms." —RENAN, "De l'Origine du Langage," p. 13 of preface.

† *Loc. cit.*, p. 59.

physics, with that of its incessant registration in chemistry and in all the biological sciences; registration often effected, moreover, by a relatively mediocre order of minds.

The child, like the race, begins at once with two sets of mental activities—sense-impressions, and speculations suggested by them and by emotional experience. Since complex objects are capable of making impressions on its senses, and of suggesting speculation, it is often both possible and profitable to study the external and perceptible characters of these objects, as well as those of simpler ones. The child, like the infant humanity, is incapable of profound anlysis, and a premature habit of analysis is morally destructive.* It is this very incapacity which makes the complexity of objects a matter of indifference, since it is only by analysis that the difference between simple and complex objects can be recognized or felt. Whatever makes a large impression upon the senses is, other things being equal, easy of apprehension, even when not of *com*prehension. Whatever does not do so, whatever demands the intervention of abstract reasoning and inference, is difficult—often so difficult as to be really impossible—even though the child pretend and appear to understand.

And thus, to return to our starting-point, it is for all of these reasons that I have preferred to introduce the world of plants by the flower, with its marvelous variety in form and color, in port and expression and inflorescence, in contrivance of petal and stamen and pistil, and in manifold destiny of fruit. I would, undoubtedly, and in accordance with the principle already laid down of indicating many things on the mental horizon before the time should arrive for paying systematic attention to them, bring forward a few salient leaves as types: the needles of the pine, the rounded floating leaves of the water-lily, the truncated leaves of the tulip-tree, the five-fingered leaves of the maple, the pinnated leaves of the sumach, the asymmetrical leaves of the begonia, the woolly leaves of the mullein. But I should reserve the systematic study of "hundreds of specimens" to a much later period, and then enter upon it with all possible enthusiasm, and prepared to especially consider the numerous mathematical relations presented by these exquisite organic forms. Not only through study of their geometric outline, but in their multiple arithmetic combinations of insertion and section, may the pupil be led to the fruitful modern methods which involve the application of mathematics to the non-mathematical sciences.†

* The effect of this is shown in the autobiography of John Stuart Mill, as the author himself points out in a striking chapter.

† See "Études comparées des Feuilles," par M. Fermond, 1864.

THE STUDY OF THE RELATIONS OF THINGS.

By ELIZA A. YOUMANS.

EVERY reader of the preceding article will recognize that it is one which I can not let pass as a final statement of the subject. Mrs. Jacobi's very first sentence is so misleading as to put me in a wrong relation to this discussion. She says, "The comments made by Miss Youman's upon a single remark in my article on primary education," etc. ; the implication of which is that I had a very slender basis for getting up a controversy. But her "single remark" was in point of fact a complete paragraph of nearly a page in length containing a series of affirmations, condemning the principles adopted as fundamental in my First Book of Botany. Her criticisms, besides, acquired special force from the circumstances in which they were made. Mrs. Jacobi is a trained scientific scholar, an independent inquirer untrammeled by traditions, and she had taken up the critical study of primary education in connection with the practical management of her own child, and published two articles on her method and its results. All this gave such strength to the case, that her incidental comment upon my method, if allowed to pass without notice, would have been more injurious than would have been a separate and formal attack. That I did not mistake the import of her first critical passage is now sufficiently apparent, as her present elaborate article is but an amplification and a justification of positions taken at the outset.

As will have been seen by the reader, Mrs. Jacobi sums up my views in five propositions upon which she comments in their order. With the first proposition she agrees, and with the second she is in partial agreement. But, while admitting that ideas of evolution are unsuitable to childhood, she insists that the idea of life and its changes is proper for their very early contemplation. I have only to say, as I said in my former article, that I have gone as far as she has done in this direction of objective study, having provided a series of experiments in the sprouting and growth of various seeds in my "First Book." But while I should be content to furnish the child with materials for simple observation, and leave him very much to himself to find out what his experiments disclose, Mrs. Jacobi would use the occasion to make "as profound an impression as possible upon the imagination" of the child in regard to "the facts of life and growth and death." With all she says of the importance of these conceptions, and the immense part they have played in the history of mankind, I entirely agree ; but I should be very cautious about undertaking to introduce them into the mind of a child, while, with its lack of experience, it is still so dominated by imagination as not to know the difference between the true and the false among ideas. Mrs. Jacobi says, "The great fact of growth and incessant change in living organ-

isms is perfectly appreciable through impressions made on his senses, and is well fitted to arouse in him lively interest and curiosity." If this be really so, then no more is needed than to furnish the child with his sprouting seeds as we both do. But surely mankind has been familiar enough with the sensible facts of germination, and yet the grossest errors concerning life-changes have prevailed through all past times. Indeed, Mrs. Jacobi quickly abandons this ground, that the child will perfectly appreciate the case, by saying it is "important to impress the imagination with typical and fundamental facts long before they can be reasoned upon or their laws really understood." I should prefer to let the child grow by slow preparation in concrete observations, till its mind gains knowledge and strength to understand typical and fundamental facts upon recondite subjects.

I gave my reasons for objecting to drawing as a means of acquiring descriptive botany. In her third proposition Mrs. Jacobi puts my view in this form: "That children should not be detained to draw the leaves, *or other natural objects they study*, because of the delay thus entailed." And, in commenting upon this, she further remarks: "If the aim at the time be *not to learn botany*, but to cultivate the observing powers of children, what danger is there in a delay which permits the object to be more deeply graven on the child's mind? Why is it so necessary to become familiar with hundreds of specimens *in a given time?*" As our object is here presumably to get at the truth, I have a right to insist upon greater correctness in the representation of my views. Mrs. Jacobi pleads to inaccuracy in her former statement of them in regard to drawing; but there are three further inaccuracies here, which I have indicated by italics, and, trivial as they may seem, they give an erroneous impression of my method. Without warrant, she introduces the phrase "other natural objects," so that a quite special objection to drawing in the endless field of observation which the study of plants presents, is generalized into opposition, on my part, to the use of natural objects as drawing-lessons. Nothing I have said can be construed into opposition to drawing, which of course has its uses; but it may also be misplaced and misused. Whenever the object is to form a habit through repetitions of a great number of simple exercises, the intrusion of such a mechanical operation as drawing must seriously hinder the work in hand. In arithmetic, for example, it is necessary to go through a great number of numerical exercises to form the habit of rapid and accurate calculation. But many of the problems involve concrete imagery which is capable of pictorial illustration. If, however, with a view of deepening his impressions, the pupil were required to make drawings of these, he would, to say the least, be very much obstructed in his mathematical progress.

Mrs. Jacobi puts it as if I had said my aim in preparing the "First Book" was not to teach botany, which is incorrect. Although the

"First Book" attempts to make a beginning only, yet it claims to begin right, and to teach botany as it should be taught, by making the mind thoroughly familiar with the actual characters of plants. Training in observation, for its mental advantages, was an accompanying purpose, because the conditions of the two perfectly coincide.

Again, in her question, "Why is it so necessary to become familiar with hundreds of specimens *in a given time?*" Mrs. Jacobi would commit me to the worst folly of current education—the time-limit in acquisition, or what may be called "fourteen-weeks" science. From the outset, and constantly, I have resisted this tendency, and have claimed that the fullest time should be taken as the first condition of real and permanent acquisition. As to the fourth proposition, I am quite content to leave it as it was presented in my article in the October Monthly.

Fifthly, and finally, Mrs. Jacobi ascribes to me as "an axiom that can not be disputed, that mental effort should advance from the simple subject to the more complex"; and she adds, that this proposition "is the one with which I most decidedly disagree." In arguing the point, Mrs. Jacobi maintains that the historic advance of knowledge has not always conformed to this principle. Very likely; but I have never said the law is everywhere observed. There are plenty of teachers who have not the slightest idea of it, and plenty of school-books which violate it, by putting the complex first, instead of leading up to it by simple steps. But where ideas are perfectly clear, as with the relations of number, experience enforces the principle; every arithmetic proceeds from the simple to the complex. All this, however, is aside from the question; my contention has been simply that the principle should not be violated in the mental cultivation of children. By the title of her first articles, "An Experiment in Primary Education," and the comments which followed, the difference between us related only to the mental conditions of childhood; but she here commits me to a statement concerning mental effort in general. Had she introduced the term *juvenile* to qualify "mental effort," she would have properly described the case, and made superfluous much that she says on the order of the evolution of knowledge. Assuming that there are stages in the progress of the individual mind, the question is as to the nature and educational significance of these successive stages, and what kind of study is appropriate at one stage and inappropriate at another. I see no way of getting light upon this matter and the practical points in issue, but by referring to the nature and constitution of the mind and the laws of mental growth. Mrs. Jacobi maintains that young children can profitably occupy their mind with things, facts, data, but are mentally unfit for the study of relations in which science consists; an examination of the part played by relations in mental structure and growth will therefore have an essential bearing upon this discussion.

The external world is made up of objects in relations with each other. Nothing exists by itself, or out of relation with other things. The very attributes which constitute a thing are its relations. The perceiving mind, on the other hand, is constituted to recognize relations. By these it identifies each thing. All objects are classed by their relations of likeness and unlikeness, and all knowledge is organized on this basis. To investigate a thing is but to determine its relations. Knowledge, in short, is relative, and our thinking is all carried on in terms of relation. The infinitely extended and the infinitely minute contexture of relations which constitutes the order of nature has for its counterpart a marvelous nervous mechanism constructed to reproduce these relations. The outer world, by its forces, acts upon the senses, producing myriads of sensations, diverse in quality and intensity, which are conveyed to the great central organ of mind, the brain. This consists of the simplest elements, cells and fibers, but there are hundreds of millions of these, closely knit and bound together by commissures, so as to produce a compactly unified organism, capable of duplicating in thought the multitudinous relations of the surrounding universe. Added to this, we have to view the brain as a creation of Nature through processes which have been going forward incessantly and continuously during vast periods of time. It has been slowly evolved by long intercourse with the environing world. It used to be thought that the mind begins with the new-born creature, and it was likened to a sheet of white paper, upon which anything can be scribbled. But it is now held that the central nervous organism at birth embodies a mass of nascent activities, latent capacities, and instinctive impulses which have been inherited from ancestral generations through the experience of the race, and in which the correspondence between the relations of external phenomena and the internal relations of the mind has been progressively increasing in extent and complexity. If, now, we glance at the early processes of the unfolding mind, we shall see that this matter of relations and their classing is very deep in the mental constitution. Mind is made up of three distinct elements, the power to feel, the power to act, and the power to know, or emotion, will, and intellect. Of these, feeling is primordial, and leads to action and to knowing. At first there is only feeling; but changes of feeling arise as soon as external forces begin to act upon the susceptible infant organism. These changes of feeling are the raw material which is to be wrought into distinct consciousness. A change of feeling supplies two terms and a relation, and the discrimination of these is the earliest act of knowing. The baby cries when in pain, and sleeps sweetly when all goes well with it. Thus at the very dawn of psychical life there are established relations of likeness and unlikeness among feelings by which they are organically classed as feelings of comfort and discomfort, pleasures and pains. Discrimination of relations is thus the very germ of intelligence. Through its apparatus of sensibility, known as

the special senses, external impulses are conveyed to the brain, light through the optical channel, sounds through the auditory nerve. But at first visible things are not seen nor sounds heard. It is only by numberless repetitions of like sensations that an impression is at length produced. Like sensations are gradually integrated until perceptions arise. As we trace onward the process by which sensations become perceptions and perceptions grow to conceptions, we find that all orders of ideas are built up out of the states of consciousness produced in us by things and their relations. As I wrote, fifteen years ago: We know things because, when we see, hear, touch, or taste them, the present impression spontaneously blends with like impressions before experienced. We know or recognize an external object, not by the single impression it produces, but because that impression revives a whole train or group of previous discriminations that are like or related to it. If something is seen, heard, felt, or tasted, which links itself to no kindred idea, we say, "We do not know it"; if it partially agrees with an idea, or revives a few discriminations, we know something about it, and the completer the agreement the more perfect the knowledge. As to know a thing is to perceive its differences from other things and its likeness to other things, it is strictly an act of *classing*. This is involved in every act of thought, for to recognize a thing is to class its impression or idea with previous states of feeling. Classification in all its aspects and applications is but the putting together of things that are alike—the grouping of objects by their resemblances; and as to know a thing is to know that it is like *this* or *that*, to know what it is like and what it is unlike we begin to classify as soon as we begin to think.

In early infancy, when the mind is first making the acquaintance of outward things, mental growth consists essentially in the production of *new ideas* by means of repetitions of sense-impressions, and in this process the pre-established relations among the cells and fibers of the brain are of the greatest possible moment. The organized and semi-organized groups of relations among the cerebral elements can give no knowledge until the special groups of relations to which they correspond have been presented to the consciousness by means of the child's daily and hourly experience of objects and activities. The attributes of size, color, weight, transparency, roughness, hardness, fluidity, warmth, taste, and various other properties of solid and liquid substances, and the aspects of people and domestic animals, are noted. Ideas of all the common objects of the house, the grounds, the walks, the drives, are soon formed and associated with words that denote them. Through its spontaneous activity it has hit upon those special co-ordinations of movement required in creeping, walking, holding things, and the like, which have greatly aided in enlarging its knowledge, so that, at the end of a few months, it has a store of complex conceptions, and has acquired numerous aptitudes and dexterities. Hence its early

ideas never arise singly, but are linked together in their origin; groups of ideas are integrated into trains of thought, and words into corresponding trains of sentences to express them. When a stock of ideas has been formed in this manner, the mental growth is mainly carried forward by the establishment of new combinations among them. The simpler ideas pertaining to the objects and actions of the child's environment being once acquired, the development of intelligence consists largely in associating them in new relations and groups of relations. The perception of likeness and difference is the essential work that is going on all the time, but the comparisons and discriminations are constantly becoming more extensive, more complex, more minute, and more accurate. Thus elementary ideas become fused into one complex idea; by a still further recognition of likeness and difference, this is associated with a new group, and this again with still larger clusters of associated ideas.

"That which occurs at this earliest stage of mental growth is exactly what takes place in the whole course of unfolding intelligence. Simple as these operations may seem, and begun by the infant as soon as it is born, in their growing complexities they constitute the whole fabric of the intellect. What we call the "mental faculties" are only different modes of the mental activity; and as one law of growth evolves all the various organs and tissues of the bodily structure, so one law of growth evolves all the diversified "faculties" of the mental structure. Under psychological analysis, the operations of reason, judgment, imagination, calculation, and the acquisitions of the most advanced minds yield at last the same simple elements—the perceptions of likenesses and differences among things thought about; while memory is simply the power of reviving these distinctions in consciousness. Whatever the object of thought, to know in what respects it differs from all other things, and in what respects it resembles them, is to know all about it—is to exhaust the action of the intellect upon it. The way the child gets its early knowledge is the way all real knowledge is obtained. When it discovers the likeness between sugar, cake, and certain fruits, that is, when it groups them in thought as *sweet*, it is making just such an induction as Newton made in discovering the law of gravitation, which was but to discover the likeness among celestial and terrestrial motions. And as with physical objects, so also with human actions. The child *may* run around the house and play with its toys, but it *must not* break things or play with fire. Here, again, are relations of likeness and unlikeness, forming a basis of moral classification. The judge on the bench is constantly doing the same thing; that is, tracing out the likenesses of given actions, and classing them as right and wrong."*

We hence see that by necessity and by the very nature of intelligence the movements of mental growth are from the relatively simple

* Essay on "The Cultivation of the Observing Powers of Children." (1870.)

to the relatively complex. The whole process is one of building simpler elements into more complicated relations, and it goes on just the same in the minds of children as of adults. The increase of knowledge, the increase of faculty, the increase of mental power, all resolve themselves into a finer discrimination, a greater clearness of perception, and a wider grasp of the relations among objects of thought. The mind can not be worked backward because its processes are organically determined; and every step of increasing intelligence is a step of increasing complication. These considerations are decisive as to the main issue of the present controversy.

Mrs. Jacobi repeatedly affirms a "pre-scientific stage" of mental development; and her whole case depends upon the validity of this position, and what she means by it. She indicates her idea of what it is by saying: "Scientific observation is observation of the relations between things; but before any attempt be made to study these relations the things themselves should be firmly and clearly apprehended." But it has been shown that this is not possible. Neither children nor anybody else can apprehend things apart from their relations; they know them either vaguely or clearly, partially or fully, only by perceiving their relations. Mrs. Jacobi's distinguishing mark of the "pre-scientific stage" thus disappears, and all the reasoning by which she would put off the study of plants in their relations, or with a view to classification to a late period of study, falls to the ground. She says, "The comparison of a multitude of objects in order to abstract their common character, and thus obtain the generic or class conception, is suited to the scientific but not to the pre-scientific stage of progress." The only meaning that can be given to this statement is that there are stages of classification too complex for children at the outset of study; but it is a grave error to suppose that the properly guided pupil is to come suddenly upon the formidable work of classification as a new task. The child has been classing things from its birth, and in its earliest observations upon the simplest parts of plants it enters upon an easy stage of classification, and it is through these exercises that the higher work is gradually reached. The process is continuous. The child from the first has been comparing objects and abstracting their common characters. It matters nothing that at first this action is automatic; it leads to conscious classing and is of the same nature with it. Progress in the formation of such general ideas as chair, cat, dog, may be clearly seen by the intelligent observer to consist in the comparison of the members of all such groups of objects and an abstraction of their common characters. Of course, this work is imperfect at first. The failures of children in forming correct general notions of some complexity was well illustrated by a little boy under three years of age, when his sympathies were appealed to in behalf of the cat he was teasing by the statement that he too was an animal. This he indignantly repelled, and, springing to his feet, he caught the skirt of his

dress and extending it toward me exclaimed, "See there, I'm *not* an animal!" Absence of clothing was thus a common character which he had generalized into the conception of an animal.

But if the essential mental processes are exactly the same in nature from first to last, in what then does science consist, and where is it to begin? There is a current notion that science is something different from common knowledge—something especially difficult to be injected late in courses of study; and Mrs. Jacobi seems to countenance this view. But we have seen that the process of thought is the same in common knowledge as in science. The difference between them is simply this, that the perceptions of relations in ordinary knowledge are loose, vague, and inaccurate, while it is the office of science to make them more careful, clear, and exact. It is simply a question of degree, and we must assume that science begins at the point where the teacher intervenes to guide the mental processes of the child, and make them more accurate and truthful. This work should be commenced sooner than has been generally supposed; and the view that the rudiments of all science are contained in the common knowledge possessed by the child necessitates a much earlier cultivation of the observing powers of children than is currently practiced. To prevent the break which commonly occurs when children enter upon the study of books and begin to substitute words for things, and to continue the processes which Nature has initiated, I sought for the simplest objects by which connected observations can be pursued, and the work of comparing, tracing out relations, and classifying can be continued, and for this purpose the simpler parts of plants are well adapted. Little children have already a large stock of ideas of the relations of concrete things. They know leaves, and stems, and flowers, though in a loose and indefinite way. The first effect of careful observation is to make these ideas more definite and precise. For instance, in place of the vague notion of leaves formed from casual acquaintance with them, the examination of a variety of leaf-forms reveals distinctly different kinds of leaves accordingly as they are made up of blade, stem, and stipule; of blade and stem; or of blade only. And each of these three definite classes receives a name with an equally definite meaning. On further observation, the blade turns out to be made up of different parts, which are to be further studied; the process of discovery and of precise naming goes on till leaves of all sorts fall into a few distinct groups, based upon definite characters and the simple recognition of these groups suffices for the beginning of classification. In the same way, from observation of stems, these fall into groups as round, square, erect, trailing, creeping, etc. Closer observation reveals still minuter characters, and the numerous individuals to be examined and described insure the repetition needful to depth and retention of impressions. In the objective study of plants the intellectual operations range from the simplest recognition of obvious likeness and difference among

leaves, stems, flowers, etc., to the perception of contrasts and resemblances among multitudes of plants, by which they are separated into genera, tribes, orders, classes, series, and various intermediate groups. But here, as everywhere, the simple leads to the complex. The limits of these groups are determined by the presence or absence of features that have been made familiar in the course of earlier study.

By the title of her article Mrs. Jacobi gives prominence to the question of precedence between the leaf and the flower with reference to the plan of my little text-book. Obviously a school-book can only imperfectly conform to the various grades of capacity it addresses. If its aim is to reach the lowest grade that can begin the work of systematic and accurate observation; and if, as the result of experience in the present case, it has been found that there is a stage of child-life when the attention may be successfully given to the study of leaf-characters, and can not be so held to the study of the flower, it would seem reasonable that the leaf should come first in the order of study. But one might not need to follow the same order with a child ten years old as with a child of six, because the former has greater capacity, and can do what the latter can not. An average child of ten years might perhaps begin observation anywhere, so far as his ability is concerned, while with an average child of five or six this could not be done. As stated in my previous article, it was necessary to begin somewhere, and the book is therefore apparently rigid in method; but I have repeatedly recommended in it that teachers exercise judgment, and skip about and choose what is most timely and appropriate to the circumstances and varying capacity of their pupils. Of course, for those teachers who think it a duty in all cases to begin at the beginning and go straight to the end, there is no help.

If, as in the present case, the dominant idea be that of self-education, if the pupil is to do his own thinking and discovering with the least possible guidance, it will be abundantly found that a young child will do this pleasurably and profitably with leaves before he can do it with flowers; for, in the case of the leaf, the mind passes more gradually from the looseness of common observation and language to the carefulness and accuracy required in the initiation of scientific study. The parts to be at first noted are more differentiated and fewer, and the number of new precise terms to mark them is smaller, and these may hence be firmly associated with the objects before fresh ones are brought forward. And, even if the method of study be purely instructional, if we point out the characters of the object to the child, and explain all about it, while he passively looks on and remembers what he may, we shall still find that the similarity and number of the different parts of the flower, and the cluster of new terms that at once crowd upon the attention, confuse and hinder, if they do not positively repel, these youngest beginners.

AGATIZED AND JASPERIZED WOOD OF ARIZONA.

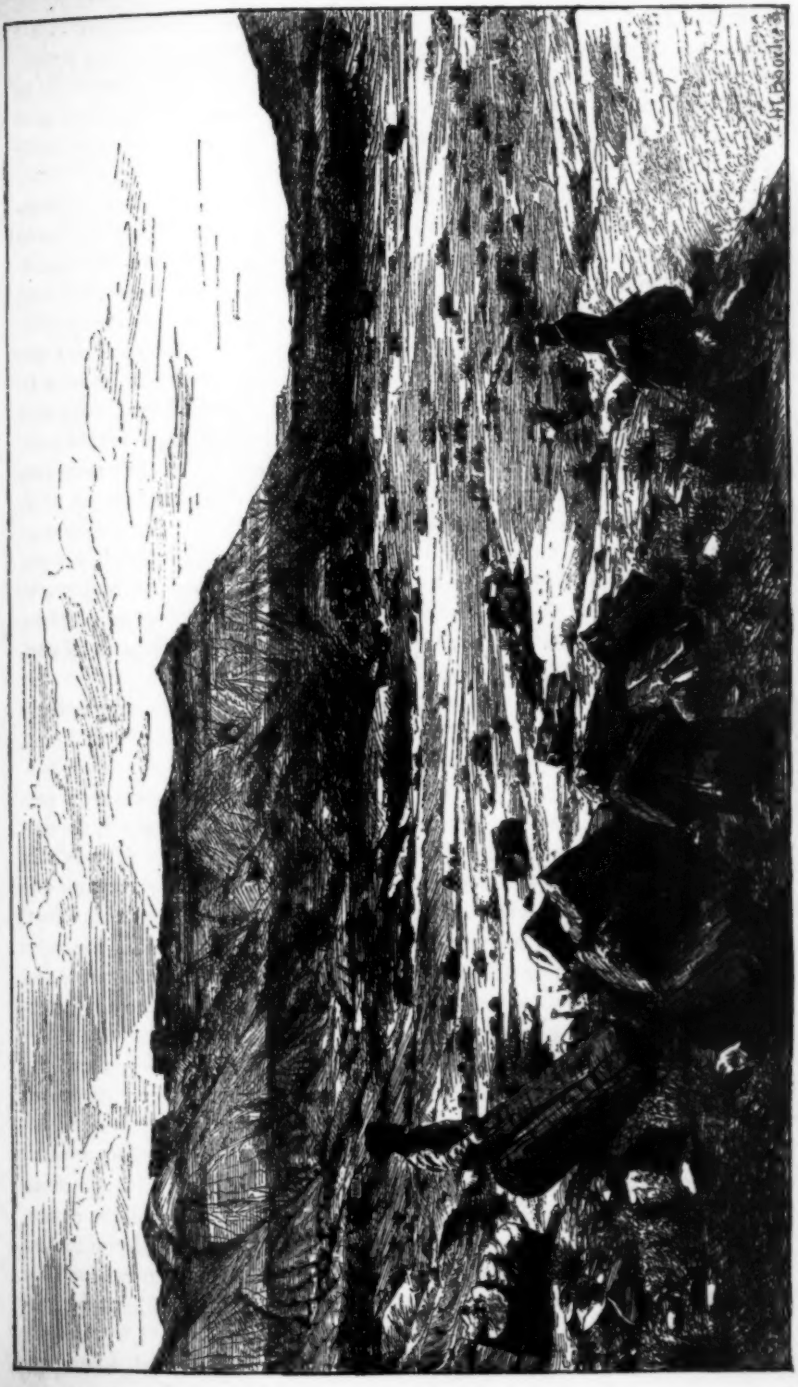
By GEORGE F. KUNZ.

UNDOUBTEDLY one of the greatest of American wonders is the silicified forest in Arizona, known as Chalcedony Park—a park only in name, however, for the giant trees which once grew there have long since fallen and silicified into agate and jasper. It is situated eight miles south of Corriza, a station on the Atlantic and Pacific Railroad, in Apache County, Arizona, twenty-four miles southeast of Holbrook. This marvelous deposit of probably a million tons of silicified trees covers a thousand acres. The wood is generally found projecting from the volcanic ash and lava, which is covered with sandstone to the depth of from twenty to thirty feet, and lies exposed in the gulches and basins where the water has worn away the sandstone.

The silicification probably took place in the following manner: The trees were overthrown and covered with volcanic ashes and tufa, the heated silicified waters, either gushing from springs or forced up by the violent volcanic action which felled the trees, percolated through the ashes, cooled on reaching the tree-level, and thus produced conditions favorable to silicification.

The moisture in the tufa may have effected a partial alteration, as also any waters that may have filtrated through it from rains or springs either hot or cold. Under these circumstances decomposition would be assisted and much silica be set free. The waters would become charged with this, the silica being held partly in solution similar to that in liquid glass, the silicate of soda of commerce. The silicious water then slowly penetrated the wood buried in the tufa and was slowly deposited in the cells of the wood. In this manner the fibers of the wood were replaced by the silica. The process was evidently a slow one, and the trees, from all appearances, were partly decayed and water-logged when the silicification took place. The jasper and agate generally replaced the cell-walls and fibers, and the transparent quartz filled the cells and interstices, especially where the structure was broken down by decay. These cell-centers and cavities produced the conditions favorable not only for the deposition of the silica as quartz, but also for the formation of the drusy, crystalline cavities of quartz and amethyst that enhance the beauty of the material so much. It is evident, from the rich variety of colors, that the waters held oxides of iron and perhaps manganese, as well as silica, the red color being caused by hematite, the yellows and browns by limonite, and the black by oxides of manganese.

It is possible also that the ash was deposited partly in water and thus heated it. There is every indication that the deposit is of con-



"CHALCEDONY PARK," LOOKING NORTH.

siderable depth. Over the entire area the trees lie scattered in all conceivable positions and in fragments of all sizes, sometimes resembling a pile of cart-wheels. A tree one hundred and fifty feet in length is often found broken up into as many sections of almost uniform length, presenting the appearance of having been sawed asunder for shingle-blocks by some prehistoric forester.

Again, we find a giant tree broken into countless fragments, ranging in size from a small pebble to a fair-sized bowlder. Perfect-shaped cubes, ready to be polished and used for paper-weights, are also found. These multiplied fractures are the result of alternate heat and cold acting on the water collected in the fissures of the tree.

The highest point in the park is some two hundred feet above the surrounding level, and it is here that the buried trees can be seen to the best advantage. Some of them are one hundred and fifty feet long and ten feet in diameter, and lie exposed in all conceivable positions. One section of a tree, which has been broken up, measures eight feet in diameter, ten feet in length, and weighs several tons. The tree was originally about two hundred feet long. Some pieces of the trunks of these trees, which were brought to New York, ranged from eight inches to three feet in diameter, and from twenty-five to one thousand pounds in weight. The perfect preservation of these trunks is remarkable. The rings are so distinctly visible as to convince even the most incredulous of their organic origin.

The most interesting points in the park have been suggestively named, The Agate or Natural Bridge, Agate Gulch, Amethyst Point, Fort Jasper, etc.

The most remarkable feature of the park, and a phenomenon perhaps unparalleled, is the Natural Bridge, of agatized wood, formed by a tree, spanning a cañon forty-five feet in depth and fifty-five in width. In addition to the span, fully fifty feet of the tree rests on one side, making the tree visible for a length of over one hundred feet. Both ends of the tree are imbedded in the sandstone. It averages three and a half feet in diameter, four feet at the thickest part, and three at the smallest. Where the bark does not adhere, the characteristic colors of jasper and agate are to be seen.

Although silicified wood is found in many localities throughout the world, nowhere is it so beautifully colored as at this place. Here we have every imaginable shade of red, yellow, brown, and green. Sometimes the colors appear in distinct spots, forming a mottled appearance; then, again, all blend so imperceptibly as to make a much more pleasing and harmonious effect than the decided banding of the agate, where the lines of demarkation between the colors are so distinct as to become obtrusive. The colors above mentioned are often relieved by white, black, and gray, and by transparent spaces of brilliant quartz-crystals, or—as sometimes occurs—of amethyst.

Broken sections of the hollow trunks are often lined with amethyst,

quartz, and calcite, which add their brilliancy to the endless variety of color.

Beautiful as the wood is to the naked eye, a microscope is needed to reveal its true beauty. Not only does the glass enhance the colors, but it also renders visible the structure, which has been perfectly preserved even to the forms of the minute cells, and is more beautiful now than before the transformation.

Dr. P. H. Dudley, of New York, microscopically examined some sections of this wood, and finds that part of it at least belongs to the genus *Araucaria*. He says that the *Araucaria excelsa*, the Norfolk Island pine of the South Pacific Ocean, grows to a height of from one hundred and fifty to two hundred feet. In radical longitudinal section, the lenticular markings on the wood-cells near each end are in double rows and contiguous, the markings of one row alternating with those of the other, giving the appearance of the beautiful hexagonal markings of this genus. In central portions of the cells sometimes only one row of markings is seen, and some cells show only one row. Medullary rays were indistinct.

Other portions resembled our red cedar (*Juniperus Virginianus*) when grown in the extreme South. The cell-structure of some indicates a growth in a mild and uniform climate, the annular rings being marked only by one, two, three, or more, slightly smaller hexagonal or rounded cells, not tabular, as is usually the case. The cell-walls were nearly uniform in thickness. All the specimens examined showed that the wood originally was undergoing decay before being filled with the various media which afterward solidified. On some of the specimens traces of fungi (*mycelium*), causing decay, were discovered. The beauty of the wood is largely due to the destructive influence of fungi.

Agate-cutting has been carried on as an industry for over three hundred years, in the Oberstein district, in Germany, but little attention has been paid heretofore to the cutting of large masses, because few agates are found over a foot in diameter, and the banding is not such as to offer much inducement. But in the future this material will doubtless be in great demand for interior house-decoration, where it can be advantageously used as inlays in wood or stone; for paneling and wainscoting walls; for tiling; and, if desired, for entire floors. Whole table-tops could be made of the largest size from a single section of one of these giant trees, and the design would be Nature's own incomparable handiwork. For mosaic-work it would also find a ready use, since the infinite diversity of color would afford an ample field for the imagination of the skillful artisans employed at this industry.

The rich, warm, blending colors, and the remarkable polish that this material is susceptible of, are the main features that will always give it a high place among minerals of its class. In fact, it is a ques-

NATURAL BRIDGE OF AGATIZED WOOD.

tion whether any of the ornamental stones, such as jade, jasper, agate, or even the marbles, have the two desired qualities to such a degree.

As before stated, the deposit has been estimated at a million tons, but probably not more than a thousand tons would be suitable for the purposes of art, while for finer work only a small part of this would be available. One instance should be noted to show the high estimation in which this wood is held by foreigners. A Russian dealer recently paid five hundred dollars for a piece twenty-eight inches in diameter and thirty inches in length, to be cut into table-tops. A large lot was recently sent abroad for cutting, and we shall soon have a new decorative stone which will possess what very few now in use do —the proper hardness.

A piece of this material was selected by Mr. Joseph Pulitzer, to form the base for the beautiful silver center-piece, which is being made by Messrs Tiffany & C., to be given as a testimonial to the eminent sculptor, F. A. Bartholdi. This base is a low truncated pyramid, eleven inches square at the base, nine inches at the top, and seven and half inches high, and is made of a single section of a tree. It was chosen on account of its superior hardness and the warmth and pleasing combination of its colors. Besides, as the designer remarked, it is eminently fitting that the testimonial should rest "on a solid American base."

This is the largest piece of such hard material that has ever been cut into a definite shape in the United States.

One of the recent freaks of fashion has been the revival of the old Scotch jewelry. The leading objection to this is the stiffness of the designs. These have in many instances, however, been Americanized and improved upon; the tame, uninteresting bloodstones and agates giving place to our own richer and brighter stones and silicified woods.

NONCONFORMITY.*

By HERBERT SPENCER.

NOTHING like that which we now call Nonconformity can be traced in societies of simple types. Devoid of the knowledge and the mental tendencies which lead to criticism and scepticism, the savage passively accepts whatever his seniors assert. Custom in the form of established belief, as well as in the form of established usage, is sacred with him: dissent from it is unheard of. And throughout long early stages of social evolution there continues, among results of this trait, the adhesion to inherited religions. It is true that during these stages numerous cults co-exist side by side; but, products as these are of the prevailing ancestor-worship, the resulting polytheism does not show

* From "Ecclesiastical Institutions," in the press of D. Appleton & Co.

us what we now understand as Nonconformity; since the devotees at the various shrines neither deny one another's gods, nor call in question in pronounced ways the current ideas concerning them. Only in cases like that of Socrates, who enunciated a conception of supernatural agents diverging widely from the popular conception of them, do we see in early societies Nonconformity properly so-called.

What we have here to deal with under this name occurs chiefly in societies which are substantially, if not literally, monotheistic; and in which there exists nominally, if not really, a tolerably uniform creed administered by a consolidated hierarchy.

Even as thus restricted, Nonconformity comprehends phenomena widely unlike in their natures; and that we may understand it, we must exclude much that is allied with it only by outward form and circumstance. Though in most cases a separating sect espouses some unauthorized version of the accepted creed; and though the nature of the espoused version is occasionally not without its significance; yet the thing specially to be noted is the attitude assumed toward ecclesiastical government. Though there is always some exercise of individual judgment; yet in early stages this is shown merely in the choice of one authority as superior to another. Only in late stages does there come an exercise of individual judgment which goes to the extent of denying ecclesiastical authority in general.

The growth of this later attitude we shall see on comparing some of the successive stages.

Ancient forms of dissent habitually stand for the authority of the past over the present; and since tradition usually brings from more barbarous ages accounts of more barbarous modes of propitiation, ancient forms of dissent are habitually revivals of practices more ascetic than those of the current religion. It was shown in § 620, that the primitive monachism originated in this way; and as Christianity, with the higher moral precepts on which it insisted, joined renunciation of ordinary life and its aims (said to be derived from the Essenes), there tended to be thereafter a continual re-genesis of dissenting sects characterized in common by austerities.

Kinds of dissent differing from these and differing from modern kinds of dissent, arose during those times in which the early church was spreading and becoming organized. For before ecclesiastical government had established itself and acquired sacredness, resistance to each new encroachment made by it, naturally led to divisions. Between the time when the authority dwelt in the Christian congregations themselves, and the time when the authority was centred in the pope, there necessarily went successive usurpations of authority, each of which gave occasion for protest. Hence, such sects, arising in the third century and onward to the seventh century, as the Noetians, Novatians, Meletians, Aerians, Donatists, Joannites, Haesitantes, Timotheans, and Athingani.

Passing over that period during which ecclesiastical power throughout Europe was rising to its climax, we come, in the twelfth century, to dissenters of more advanced types; who, with or without differences of doctrine, rebelled against the then-existing church government. Such sects as the Arnoldists in Italy, the Petrobrusians, Caputiati and Waldenses in France, and afterward the Stedingers in Germany and the Apostolicals in Italy, are examples; severally characterized by assertion of individual freedom, alike in judgment and action. Ordinarily holding doctrines called heretical, the promulgation of which was itself a tacit denial of ecclesiastical authority (though a denial habitually based on submission to an alleged higher authority), sects of this kind went on increasing in the fourteenth and fifteenth centuries. There were the Lollards in England; the Fraticelli in Italy; the Taborites, Bohemian Brethren, Moravians and Hussites, in Bohemia: all setting themselves against church-discipline. And then the rebellious movement of the reformation, as carried forward by the Lutherans in Germany, the Zwinglians and Calvinists in Switzerland, the Huguenots in France, the Anabaptists and Presbyterians in England, exhibited, along with repudiation of various established doctrines, ceremonies, and usages, a more pronounced anti-sacerdotalism. Characterized in common by opposition to Episcopacy, protestant or catholic, we see first of all in the government by presbyters, adopted by sundry of these dissenting bodies, a step toward freedom of judgment and practice in religious matters, accompanied by denial of priestly inspiration. And then in the subsequent rise of the Independents, taking for their distinctive principle the right of each congregation to govern itself, we see a further advance in that anti-sacerdotal movement which reached its extreme in the next century with the Quakers; who, going directly to the fountain head of the creed, and carrying out more consistently than usual the professed right of private judgment, repudiated the entire paraphernalia of ecclesiasticism.

It is true that the histories of these various non-conforming bodies, not excluding even the Society of Friends, show us the re-growth of a coercive rule, allied to that against which there had been rebellion. Of religious revolutions, as of political revolutions, it is true that in the absence of differences of character and culture greater than can be expected in the same society at the same time, they are followed by gradually established forms of rule only in some degree better than those diverged from. In his assumption of infallibility, and his measures for enforcing conformity, Calvin was a pope comparable with any who issued bulls from the Vatican. The discipline of the Scottish Presbyterians was as despotic, as rigorous, and as relentless as any which Catholicism had enforced. The Puritans of New England were as positive in their dogmas, and as severe in their persecutions, as were the ecclesiastics of the church they left behind. Some of these dissenting bodies, indeed, as the Wesleyans, have developed organizations

scarcely less priestly, and, in some respects, more coercive, than the organization of the church from which they diverged. Even among the Quakers, notwithstanding the pronounced individuality implied by their theory, there has grown up a definite creed and a body exercising control.

Modern Nonconformity in England has much more decidedly exhibited the essential trait of anti-sacerdotalism. It has done this in various minor ways as well as in a major way.

There is the multiplication of sects, with which by foreign observers England is reproached, but which, philosophically considered, is one of her superior traits. For the rise of every new sect, implying a re-assertion of the right of private judgment, is a collateral result of the nature which makes free institutions possible.

Still more significant do we see this multiplication of sects to be if we consider the assigned causes of division. Take, for instance, the case of the Wesleyans. In 1797 the Methodist New Connexion organized itself on the principle of lay participation in church government. In 1810 the Primitive Methodists left the original body: the cause being a desire to have "lay representatives to the Conference." Again, in 1834, prompted by opposition to priestly power, the Wesleyan Methodist Association was formed: its members claiming more influence for the laity, and resisting central interference with local government. And then in 1849, there was yet another secession from the Methodist body, similarly characterized by resistance to ministerial authority.

Of course, in sects less coercively governed, there have been fewer occasions for rebellions against priestly control; but there are not wanting illustrations, some of them supplied even by the small and free bodies of the Unitarians, of this tendency to divide in pursuance of the right of private judgment. Moreover, in the absence of a dissidence sufficiently great to produce secession, there is everywhere a large amount of express disagreement on minor points among those holding what is supposed to be the same body of beliefs. Perhaps the most curious instance of this is furnished by the established Church. I do not refer simply to its divisions into high, and low, and broad; all implying more or less of the nonconforming spirit within it. I refer more especially to the strange anomaly that the ritualists are men who, while asserting priestly authority, are themselves rebels against priestly authority—defy their ecclesiastical superiors in their determination to assert ecclesiastical supremacy.

But the universally admitted claim to religious freedom shown in these various ways, is shown still more by the growing movement for disestablishment of the Church. This movement, which, besides tacitly denying all sacerdotal authority, denies the power of a government, even though elected by a majority of votes, to prescribe religious belief or practice, is the logical outcome of the Protestant theory.

Liberty of thought, long asserted and more and more displayed, is about to be carried to the extent that no man shall be constrained to support another man's creed.

Evidently the arrival at this state completes that social differentiation which began when the primitive chief first deputed his priestly function.

As implied in the last sentence, the changes above sketched out are concomitants of the changes sketched out in the last chapter. The prolonged conflict between Church and State accompanying their differentiation, and ending in the subordination of the Church, has been accompanied by these collateral minor conflicts between the Church and recalcitrant portions of its members, ending in separation of them.

There is a further implication. In common with the subjection of the Church to the State, the spread of Nonconformity is an indirect result of growing industrialism. The moral nature proper to a social organization based on contract instead of *status*—the moral nature fostered by a social life carried on under voluntary co-operation instead of compulsory co-operation, is one which works out religious independence as it works out political freedom. And this conclusion, manifest *a priori*, is verified *a posteriori* in sundry ways. We see that Nonconformity, increasing as industrialism has developed, now characterizes in the greatest degree those nations which are most characterized by development of the industrial type—America and England. And we also see that in England itself, the contrast between urban and rural populations, as well as the contrast between populations in different parts of the kingdom, show that where the industrial type of life and organization predominates, Nonconformity is the most pronounced.

A NEW FIELD OF AMERICAN HISTORY.

WE have hitherto been accustomed to treat the history of the United States as consisting primarily of the history of the Atlantic portion. When it has become necessary in the progress of the review to advert to the history of other parts of the continent, the subject has been considered as related to the history of the Eastern States, and subordinated to it. This may have been proper so long as the historical nation lay east of the Mississippi River, but when Louisiana was bought we took in a region with an independent history of its own; when the question of the title to Oregon was agitated, an historical inquiry in a new direction became of great importance to us; and when California was acquired we came into possession of still another history, antedating that of our original States by a hundred years, and unexcelled in its fullness of romance and adventure.

Still, the making of our text-books and new histories has been going on with the Atlantic States marking the beginnings and the Pacific domain introduced as a product of the present century, with a mere reference to its three hundred years of romantic past. For any notices of that we must go to books about Mexico, to find very little of it there. Some of the earliest and most interesting developments of the history of the country as we now know it were worked out on the Pacific coast; but their story was hidden in masses of documents and loose records that were inaccessible to ordinary historians till Mr. Hubert H. Bancroft unearthed them for presentation in solid form in his "History of the Pacific States of North America."

This history, when completed, will fill thirty-nine volumes, of which eighteen have now been published. It consists of two series, of which the first series, published ten years ago in five volumes, gives all that was known at that time of the native races. As there has been some discussion, and it is growing more lively, about the theories of these races, and the author's position in the matter has been brought into question, it is proper to say here that he disavows having anything to do with theories or the solution of disputed questions. His purpose has simply been to collect all the material that is worthy of notice, and put it where it will be accessible, making only such critical observations as suggest themselves in course, leaving closer special investigations to future students. The richness of the material he has provided and put here, in the hands of such investigators, can not fail to be of great help to them. Without it they might have to work for years to secure a position of knowledge available for comparative research, where they now find themselves at the start.

The first two of the volumes on the native races are devoted to the ethnographical description of the tribes; the third to their myths and language; the fourth to their antiquities; and the fifth to their primitive history. The tribes are classified, for convenience of treatment rather than to conform to a scientifically accurate standard, into geographical groups, as Hyperboreans, those natives whose territory lies north of the fifty-fifth parallel; Columbians, between the fifty-fifth and forty-second parallels, and mainly in the valley of the Columbia and its tributaries; Californians and the inhabitants of the Great Basin, New Mexicans, Wild Tribes of Mexico, Wild Tribes of Central America, and Civilized Natives of Mexico and Central America, the last having a volume to themselves. In these descriptions the author aims to portray such customs and characteristics as were peculiar to each people at the time of its first intercourse with European strangers, leaving scientific inquirers to make their own deductions. Much of the ground covered by the accounts has been gone over in later years by the new school of American ethnologists, whose observations have been fully published by the Government bureaus and various archæological societies, and have added considerably to what Mr. Bancroft

was able to tell when he wrote, or have modified its bearing. In cases where they seem to contradict his authorities, the question is in place whether it is a rule that observations on Indians, after they have been for two or three hundred years in contact with white men, are more accurate as to what they were primarily than the accounts of those who saw them uncontaminated, even though their methods may not have been so closely trimmed to the scientific rule. In reading the rapid sketches of the characteristics of these people, we are struck by many suggestive points. Some force the thought that there is in the lowest of them something that tends to lift them above their usual level; some remind us how much alike are men, even in the most diverse conditions and places and ages; and some that the doctrine of evolution is not wholly a conception of civilized philosophy or the product of the thought of ages. How different from their usual life is that feeling that prompts the Central Californian Indians, who appear to be the old "diggers," and who live in bestial laziness, to such a regard for the woodpecker that they will not touch its property of stored acorns till they are driven to it by the extreme of hunger!

A remarkable contrast is afforded by two tribes living close to one another in New Mexico: the Apaches, who have a regular system of numeration, with a name for every number up to ten thousand; and the Comanches, who can not count further than their fingers or some other visible objects will carry them, and can not calculate at all.

The Indians of Zacatecas have a ceremony corresponding with that of the "blood-covenant," which is characteristic of the south Slavic nations in Europe, and is found among many Eastern and African peoples.

In the legend of the Indians of Mount Shasta, which describes the descent of man from a family of grizzly bears, who were somewhat different then from what they are at present, walking on their hind-legs like men, talking, and carrying clubs in their fore-limbs; in the Aht myth, which traces man's descent from the essences or embryos residing in them which the animals left behind when they fled from the sight of two beings in the shape of men; and in other stories of origins, we have glimpses of a kind of primitive doctrine of evolution. There are also stories teaching an inverse evolution, or the doctrine of degeneracy, in the descent of beasts, fishes, and even edible roots from human originals. Most curious is the Mexican doctrine of the future state and the wanderings of the spirit, which, except that the journey is briefer and the perils are correspondingly less numerous, might have been extracted from the Egyptian "Book of the Dead."

On this subject, and respecting the languages of these people, after having presented and compared them, the author says: "He who carefully examines the myths and languages of the aboriginal nations of the Pacific States can not fail to be impressed with the similarity between them and the beliefs and tongues of mankind elsewhere. Here

is the same insatiate thirst to know the unknowable, here are the same audacious attempts to tear asunder the veil, the same fashioning and peopling of worlds, laying out and circumscribing of celestial regions, and manufacturing, and setting up, spiritually and materially, of creators, man, and animal-makers and rulers, everywhere manifest. Here is apparent what would seem to be the same inherent necessity for worship, for propitiation, for purification, or a cleansing from sin, for atonement and sacrifice, with all the symbols and paraphernalia of natural and artificial religion. In their speech the same grammatical constructions are seen with the usual variations in form and scope, in poverty and richness, which are found in nations, rude or cultivated, everywhere. Little as we know of the beginning and end of things, we can but feel, as fresh facts are brought to light and new comparisons made between the races and ages of the earth, that humanity, of whatsoever origin it may be or howsoever circumstanced, is formed on one model, and unfolds under the influence of an inspiration."

The second series, beginning with Volume VI, counting the whole work, will comprise the history of the several States under white dominion. Three volumes, when completed, will be devoted to Central America; six to Mexico; two to the North Mexican States and Texas; one to Arizona and New Mexico; seven to California; one to Nevada, Wyoming, and Colorado; one to Utah; two each to the Northwest Coast and Oregon; one to Washington, Idaho, and Montana; one each to British Columbia and Alaska; one to "California Pastoral," or its life and society before the discovery of gold; and one to "California Interpocula," or during the gold-mining epoch; two to "Popular Tribunals," or lynch-law and vigilance committees; and two will be of a miscellaneous character. The latest published volume, the twentieth in the order of numbering, which follows the geographical arrangement, or the eighteenth in the order of publication, which is according to the chronology, is the third of the history of California, and relates the story of that region as a "Territory under the Mexican Republic," from 1825 to 1840. The facts, mostly political, military, and financial in their bearing, are presented in a clear and satisfactory manner, so as to give those who are interested in those lines of development a connected view of their course, both in the territory as a whole, and in its several districts. The secularization of the church missions, which was largely accomplished during this period, and its immediate results, present interesting phases of social development worthy of the attention of the student of that subject. The incursions of foreigners, which have eventually revolutionized the aspect and the fate of the whole region, are traced back to their beginnings in individual visits from abroad which were often accidental, generally transient, and nearly always precarious; for the powers that ruled in those days were disposed to regard strangers much as they would wild beasts. For forty years, California had been vis-

ited with increasing frequency by foreigners, or persons whose blood was neither Indian nor Spanish. England, the United States, Russia, and France were the nations chiefly represented. "All had come from the South, or West, or North, by the broad highway of the Pacific Ocean, bounding the territory on the west, and leading to within a few miles of the most inland Spanish settlements." The inland boundary—an arc for the most part of *sierras nevadas* so far as could be seen, with a zone of desert beyond still unknown—had never yet been crossed by man of foreign race, nor trod, if we except the southern segment cut by a line from San Gabriel to Mojave, by other than aboriginal feet. The "grand advance movement" of fur-hunting pioneers began in 1826, "when the inland barrier of mountain and desert was first passed, and from that date the influx of foreigners by overland routes becomes a topic of ever-growing importance." But no record of even tolerable completeness exists or could be expected to exist concerning it. The movement was generally directed farther north, but some of the trappers found their way into California. Those foreigners who came to stay seemed to enjoy an appreciation of their worth, and to have been liked by the people, with less prejudice against them, perhaps, than was felt against Mexicans. Citizenship, wives, and lands were easily obtained by those whose conduct was regular. "New-comers had to comply with certain formalities, and they were occassionally reminded that they were under surveillance, but no cases of oppression were recorded." The first recorded trip overland was made in 1826, by Jedediah S. Smith, who went from the Great Salt Lake by the Virgin and Colorado Rivers. Returning, he was the first to cross the Sierra Nevada, in May and June, 1827. Science is interested in two of the transient visitors of whom record is made in this period. The first was David Douglas, the famous Scotch botanist, who, after having spent five or six years in botanical researches in the North, came down from the Columbia to investigate the flora of California, arriving at Monterey in December, 1830. He had letters and influence, by the aid of which he obtained permission to prosecute his researches for six months, and, in fact, remained for twenty months. To return to British Columbia, he had to take a roundabout voyage by way of Honolulu. There was a current rumor in later years that he had found on the roots of his California plants gold enough to make a watch-seal! He perished in 1834 by falling into a pit, where he was trampled to death by a wild bull that had fallen in before him. The botanical results of his trip were published by Sir William Hooker in 1841. The other scientific visitor was Dr. Thomas Coulter, who in 1832 communicated to the London Geographical Society the results of a trip from Monterey *via* San Gabriel to the Rio Colorado and back, made in 1832. He published a map, which included the country as far north as the Bay of San Francisco and as far east as the Tule Lakes.

We have reason to anticipate a fullness of information, wholly new to the Gentile world, when the volume devoted to Utah is reached. For not only has Mr. Bancroft all the documents and all the material for the history of the Mormons which is accessible to any one else, but he is the exclusive possessor of that which is more valuable than all this, and which has never seen the light. The ruling men of the Mormon Church have given him the privilege of examining their archives, containing documents going back to the beginning of their movement. We have the Gentile story in superfluity and in unpleasant satiety; Mr. Bancroft purposes to give us the Mormon side in addition uncolored, and told as a part of the *res gesta*, and that is what the world wants to know.

The task which Mr. Bancroft undertook in the preparation of so comprehensive a work as this was one of unusual magnitude, and might well have discouraged a less earnest man. It certainly required unusual powers of application and painstaking labor to give unity and harmony to so large a plan; to reduce such a chaos of material as the history has to be built up out of to manageable shape, and to organize the work so that all should be done intelligently, consistently, and discriminatingly. But the plan is substantially executed, and one half of the work it demanded is done and in the possession of the public, while the rest of it is, we are told, in so advanced a stage of forwardness that its completion no longer depends on the prolongation of the life of the author.

The scheme contemplated the presentation in a systematized, readable, and plainly intelligible form, both in general view and in all its details and with all its changes of scene, of the history, so far as it is known or has been reported, of the tribes and states of the Pacific slope of the North American Continent from the Isthmus of Darien to Behring Strait. When we consider what these states are; what elements have entered into their composition; what vicissitudes and revolutions they have gone through during the four hundred years they have been known to white men; and how all the material is colored in all discordant hues by ignorance, partisan prejudice, or political malice prepense—it would seem almost a hopeless task to obtain comprehension even of a small part of the confused whole. Add to this, that hundreds of native tribes, having a vast geographical range and living in the most various conditions of pursuit, wealth, and civilization, had to be dealt with, and that what was to be learned about them had to be gathered and sifted from a great accumulation of printed and manuscript accounts, true and false, guessed, imaginary, and real, and from myths and traditions going back to an unknown antiquity, here obscure, and there inextricably entangled in and modifying one another—and we conceive a task calling for no slight powers of mental organization. Forty-two thousand is the number of books and manuscripts Mr. Bancroft has levied upon for his great undertaking! It took six

men ten years suitably to catalogue and index thirty-five thousand of them so that they could be available for use, while the others have been gradually added. Mr. Bancroft has spent twenty-five of his best years in his work, and is spending and expects to spend other years upon it; while the pecuniary cost to him is underestimated at a million dollars.

The author has not produced, nor has he aimed to produce, a critical history nor a philosophical history, but simply to collect and preserve what existed, but was in danger of being lost. For doing that he deserves the thanks of his countrymen.

NATURAL HEIRSHIP: OR, ALL THE WORLD AKIN.

By Rev. HENRY KENDALL.

THE number of a man's ancestors doubles in every generation as his descent is traced upward. In the first generation he reckons only two ancestors, his father and mother. In the second generation the two are converted into four, since he had two grandfathers and two grandmothers. But each of these four had two parents, and thus in the third generation there are found to be eight ancestors—that is, eight great-grandparents. In the fourth generation the number of ancestors is sixteen; in the fifth, thirty-two; in the sixth, sixty-four; in the seventh, 128. In the tenth it has risen to 1,024; in the twentieth it becomes 1,048,576; in the thirtieth no fewer than 1,073,741,824. To ascend no higher than the twenty-fourth generation we reach the sum of 16,777,216, which is a great deal more than all the inhabitants of Great Britain when that generation was in existence. For, if we reckon a generation at thirty-three years, twenty-four of such will carry us back 792 years, or to A. D. 1093, when William the Conqueror had been sleeping in his grave at Caen only six years, and his son William II, surnamed Rufus, was reigning over the land. At that time the total number of the inhabitants of England could have been little more than two millions, the amount at which it is estimated during the reign of the Conqueror. It was only one eighth of a nineteenth-century man's ancestors if the normal ratio of progression, as just shown by a simple process of arithmetic, had received no check, and if it had not been bounded by the limits of the population of the country. Since the result of the law of progression, had there been room for its expansion, would have been eight times the actual population, by so much the more is it certain that the lines of every Englishman's ancestry run up to every man and every woman in the reign of William I from the king and queen downward, who left descendants in the island, and whose progeny has not died out there.

It is a delusion to suppose that one man living seven or eight hundred years ago was one's ancestor to the exclusion of all the rest of the people living at that time in the country, and still having descendants in it. We have sprung from the whole mass; they were all our direct ancestors; we are vitally related to them all, directly descended from them all. Heraldry follows only one line of succession, the line of the eldest surviving son, the line that carries name and title and landed property. It is commonly imagined that one standing in this line of succession is more truly a descendant than other descendants. It is supposed that the eldest sons all the way are more truly descendants than the progeny of younger sons, or the posterity of daughters who have lost the very name. But each line of descent, whether by younger sons or by daughters, is just as real and as close as the one termed lineal agnatic. Every ancestor living 700 years ago has contributed as truly to the vitality of a present representative as the one whose name he bears, and whose peculiarly direct descendant he is considered to be.

It is morally certain, then, that all Englishmen of this generation are descendants of William the Conqueror and of Alfred the Great, and all the nobles of their times whose posterity have not died out. When we read in history of a brave deed done by an Englishman seven centuries since or more, we may say with confidence it was done by one of our fore-elders. And, when we read of one at that distant period who was a dishonor to his country, we may say with certainty he also was one of our ancestors. All the lords, princes, and sovereigns, all the wise and good, the moral and intellectual aristocracy, were our forefathers, and we are their children by direct descent. Equally all the toiling myriads, without distinction of any kind, all the beggars and vagabonds, all the villains and scoundrels, were our forefathers, whoever we may boast ourselves to be, if, indeed, they have left descendants in the land. We are of them, and their blood circulates in our veins.

If the fact of our equal descent from so many ancestors be doubted, let the matter be tested arithmetically within the circle of two or three generations. The grandmother on the mother's side was equally my ancestor with the grandfather on the father's side. She was one of four ancestors that I had in the second generation, and owns a full quarter of me. The great-grandmother on the mother's side is equally an ancestor with the great-grandfather on the father's side. She was one of eight ancestors that I had in the third generation, and claims a full eighth of me. Similarly all standing on the successive steps of genealogical descent, and whose number is seen to be doubled at every step as we rise from the lowest upward, stand on the same level, and have equal claim to ownership in those coming after them.

Some deduction has doubtless to be made from the above rule on account of the recurrence, to a certain extent, of the same lines of de-

scent. Thus, if the father and mother are cousins, their children have only six great-grandparents instead of eight. If the grandfather on the father's side, and the grandfather on the mother's side, were brothers, their lines run up into one house, and not two separate houses, according to the common rule. Many lines must thus blend in the course of ages, and the multiplication of distinct ancestors be thus somewhat retarded. But, notwithstanding this deduction, it would require a miracle to prevent the interfusion of the blood of a whole nation within a brief period.

When we have gone back far enough for all the inhabitants of our country to have become related to us as fore-elders, they will be found, as we still travel backward, to go on for the most part intermarrying within the lines of consanguinity as drawn backward from us. The great majority of the marriages will be, of course, between men and women of the same country and the same race, who, by the operation of the law now expounded, have all been ascertained to be our ancestors. The boundaries of a country, especially in an island like ours, resemble the shores of a lake from which there is no outlet, and where the currents must circulate round and round the same basin.

Yet, as the self-contained lake does somehow manage to communicate with the great world of waters outside, as, for instance, by rain and by evaporation, so the multiplication of distinct ancestors, while retarded by nationality, is not arrested. Genealogy has curious means of planting new centers in other lands, and commencing there over again the same rapid ratio of multiplication, till successive nationalities are brought into intimate relationship. Let an ancestor be brought into the English succession from another country, and, since he can be shown to be in the course of a few generations related to all the people of that country, forthwith by his marriage here the whole nation to which he belongs is brought into our succession. One Frenchman embodies in himself, in miniature, all the French people of past times; one negro represents all the race from which he has sprung. Ancestral germs have thus been conveyed across the sea by emigration from France, from Germany, from India, and from the remotest regions to these shores, and by these means all the people of the earth will be found at no very distant period to have been brought into close kinship with us. The Norman conquest brought in all at once a large foreign element, expediting immensely our union with the people of whom they were part. The Danish invasions did the same at an earlier age; the expatriation of the Huguenots the same much later. All the world are found akin, not by going so far back as Adam, or even Noah, but within historical times.

It is often said, respecting a distant relative, "he is a thirty-second cousin." The truth is, perhaps, that he is a second or third cousin. As to thirty-second cousinship, it is startling to find that the whole human race comes within this line of consanguinity. By the ordinary

unimpeded ratio at which ancestors multiply, they would amount in the thirty-second generation to 4,294,767,296; and, reckoning for all the checks to this ratio through the blending of lines of ancestry, they must be reasonably estimated at the entire population of the globe—as high, in fact, as they can possibly go. The Caffre and the Hottentot, the Japanese and the Chinese, are doubtless all of them the reader's thirty-second cousins, or nearer.

There is a tendency from many causes for ancestry to diverge and spread itself over an ever-widening area; there is a struggle of the lines to part until universality has been reached, and every human being has come into the succession. Even where a tribal or religious custom mostly confines the marriages of the men in a community to the women of the same community, there are sure to be many exceptions. Jews sometimes marry Gentiles, and set the barrier that interposed between them at defiance. Boaz married Ruth, and she brought into Judah blood mingled of all Moab. When the Quakers made it a rigorous rule that members of the society should marry only with members, gates were hung in the hedge, and the fence itself was often broken through. Proselytes were brought in from the outside; members married non-members at the cost of excommunication. The law itself had eventually to be abrogated.

The tendency to avoid kinship in marriage has helped to increase the divergence of ancestral lines. While a large proportion of the marriages consummated are between persons living in the same district, the population of the district itself is continually undergoing modification—one stream flowing in, another flowing out. No use has been made in this argument of the existence of illegitimacy, and the boundless license of many periods of our national history. Yet doubtless moral transgression has greatly widened the area of relationship, and mingled in an indistinguishable mass the offspring of the rich and poor.

Hitherto we have been looking backward at the historical multiplication of the ancestors of persons now living. If we reverse the process, and apply the law of multiplication to the future, the result is equally startling. The average number of children may be reckoned on a moderate computation at two for every household. According to this average, a man who leaves permanent posterity behind him has the number of his descendants doubled every generation. The two children are followed by four grandchildren; the four grandchildren by eight great-grandchildren. At the twenty-sixth generation the number has swelled to 67,006,624. A few more generations would render them equal to the total number of the inhabitants of the globe. So that, if one could rise from the grave at a period no further removed from us in the future than the Conquest in the past, every person he met in the land, man, woman, or child, if not a mere visitor or recent immigrant, would be one of his descendants. Every

one of them would inherit something of his nature. All would be his posterity, one as direct as another. The honorable and the base, the rich and the poor, the talented and the imbecile, would alike belong to his family, now swelled to gigantic proportions through the multiplying power of time. Broadly speaking, all the inhabitants of this country about eight hundred years ago were our fathers and mothers; all the inhabitants of this country about eight hundred years hence will be our children.

The low rate of multiplication just given is often seen to be greatly exceeded. The number of grandchildren and of great grandchildren which some individuals leave behind them at death makes it easy to believe that in a few centuries an entire nation will be their veritable sons and daughters. While I have been writing this paper an old woman has died very near to my residence at the age of ninety-nine, who had thirteen children and one hundred and two grandchildren and great-grandchildren, the latter, so far as known, all living. During the same time that the paper has been in progress, a Spanish gentleman who went out many years ago to America has returned to his own country, bringing back with him no fewer than one hundred and ninety-seven actual descendants.

A single plant, if unresisted by rival plants and unchecked by such things as climate and situation, would speedily cover the whole earth. Man has really no rival, he is lord of all; he can live too in every clime, and obtain a livelihood amid tropical forests and amid eternal snows. The rapidity with which the multiplication of descendants must go forward, even according to the ordinary rate of progression, will in the course of not many generations make the whole world our children, much more if it be expedited. Successive countries will be captured by various avenues and held in perpetual possession by our posterity. The whole caldron of humanity, seething evermore with new creations, will acknowledge the presence of every individual progenitor of this period.

The race is incalculably more than the individual. The peculiarities of the individual are soon melted away in the general stream of humanity. As if his brief sway in the little circle he has filled were viewed with envy or dissatisfaction, the hand of Time begins immediately to pare down what remains of him in the earth to ever smaller dimensions until it is infinitesimal. He can insure only half of himself in any individual of the next generation, only a quarter in the generation after that, and so on. His part in the building up of any human fabric rapidly becomes insignificant. Something seems bent on working him out. As it does with his name and memorials, filling up the lettering on his tombstone with moss, destroying the writing he has left behind, wiping out all traces of him from the earth, so it does with himself and all that vitally represents his personality in the persons of his descendants. The individual is ever

losing; the race is ever gaining. A man's great-great-great-grandchild, living scarcely two hundred years after him, will be only one thirty-second part of himself, and the other thirty-one parts will be due to others, that is, to the race viewed as something opposed to his individuality.

The gain in the way of extension compensates for the loss of intension. While a man's part in the individuals descending from him rapidly becomes infinitesimal, the number of individuals in whom he has part rapidly increases until it includes, as we have seen, all the nation and then all the world. This widening out of his personality corresponds to the broadening of intelligence from mere interest in local news to that which is taken in scientific generalizations, and to the tendency of moral development which is to expand the love of family into patriotism, and then to convert patriotism into philanthropy, into a regard for man as man, irrespective of language or nationality. Thus the brook seeks the river, the river the sea, the sea the vast ocean.

Each man's personality, it has to be remembered, is borrowed from those behind him. The further back in time a man's place may be, the fewer ancestors he has behind him; the greater, too, his own part in the race, viewed as a whole existent through the ages, the oftener the infinitesimal resowing of him takes place, and the greater becomes the certainty that every separate inhabitant of the earth is one of his descendants. Furthermore, when there are fewer people, the lines of ancestry blend oftener, so that in the same individual it is more probable that an ancestor will be represented many times by means of different channels of descent meeting in him after proceeding from the same source. Posterity, not very remote, will have descended from a common ancestor through several of his children. A progenitor's part who lived three thousand years ago is very much larger than that of one who lived only one hundred or three hundred years ago. He has had more to do in the shaping and molding of the whole, just as the stem has more to do in the formation of the tree than any particular branch proceeding from it. The root or the seed has a still greater part, and, if it be conceded that the human race has proceeded from one common pair, it follows that of the nature of all the individuals now living half is of the proto-father and half of the first mother. To us existing at this late date, it is interesting to note how the channels of vitality, proceeding from the original pair to us, first diverge until they reach their numerical climax, and are coincident for a considerable period with all the inhabitants of the world; then converge until they are found reduced to two again in the household from which we immediately sprang.

As the people at no very distant date in the past were all our fathers and mothers, and the people who will be living not very far distant in the future will be all our sons and daughters, so the people living at the present time are all our near relations. We may call them, with very

little exaggeration, brothers and sisters. If we could be told, as we meet the passers in the streets, how near their relationship to us is, we should get a succession of surprises. We should cease to think of them as strangers and aliens, and come to feel that they were our own kith and kin. Every person would have an interest for us as a relative not far removed, and the charm of social life would be wonderfully increased.

The fact of our close kinship, as a nation, and also as a race, is calculated to stimulate philanthropy very powerfully. It is acknowledged that the nearer the relationship the greater is the claim for help, if help be needed. Even self-love comes to the aid of generosity; it is felt that what a man does for his own relations is in a measure done for himself; the disgrace of neglecting them acts as a useful spur to liberality. Advocates of slavery have vindicated their obnoxious system by maintaining the absolute inferiority of the enslaved. Caste in India has been fortified by notions of a vast and essential difference between the various orders. Oneness in nature appeals for respect and association. The oneness which is proved and emphasized by near relationship makes the strongest appeal to the interest of the mind and the sympathy of the heart. Creatures of the same kind draw together. The further a people are from us, geographically or relatively, the less ordinarily is our regard for their welfare, our concern over their calamities. The improved facilities for intercourse are destroying the effect of geographical distance; the realization of the fact that all the world are near akin will help immensely to lessen the social distance.

The close kinship of mankind especially in the same nation has an important bearing on one or two points of theology. Since mental and physical tendencies are transmissible by hereditary descent, this kinship gives to the doctrine of natural depravity an awful significance, and shows the causes of taint to our blood to be near us in time instead of being removed altogether away to the beginning of the world. If all the moral weaklings of the land who lived seven hundred years ago, all the vile and vicious, all the wild beasts in human shape, and an unknown number of such in the ages intervening, were our direct ancestors, it is not to be wondered at that unhappy propensities stir, and strive, and struggle for mastery in every man's breast. It is singular that orthodox theologians should overlook this recent pressing source of depravity to dwell on the influence upon us of an original pair living before historical times. It is equally strange that unorthodox ones should deny the existence of depravity communicated from that remote period on the ground of its supposed injustice, when it is undeniable that we are reached by ten thousand impure channels so near at hand. The question arises, How is it that the depravity fed from so many sources has not resulted before now in the complete corruption and disintegration of the race? We are able to encourage ourselves by remembering the vast amount of excellency in recent times with which we are in direct communication; the heroes, saints, and martyrs, to say nothing of the

hosts of good, plain, practical people of all sorts who have left us a constitutional heritage. We have further encouragement in the law by which successive generations tend to revert to a normal type: peculiarities are got rid of, defects are supplemented, excesses are restrained; a certain amount of refuse is wrought out and cast aside age after age. The blind man has children with eyes. On the whole, we can not marvel that with such a mongrel ancestry of saints and sinners we manifest such contradictory tendencies, and are such an enigma to ourselves, as if not two men but a thousand were contending within us for the dominion in the changing moods that pass over us, and in the wild, irregular thoughts that shoot through the mind, and try to find their way to the surface to gain their own appropriate expression. That blessing and cursing should proceed from the same lips, that men should come away from prayers at church and get into very unlovely tempers at home, is doubtless very sad, but it is just what might have been expected from those who reckon among their progenitors the evil and the good, the best and the worst, of a whole country.

This doctrine of the close kinship of mankind triumphantly establishes, apart from genealogical tables, the fact that Jesus Christ had descendants from King David, but impairs the value of the fact when it is established. David, the King of Israel, flourished above a thousand years before Christ, and left behind him many children. The channels of succession being so numerous, and having their fountain-head so far back, had time before the birth of Christ to branch out in every direction, and could not have missed any genuine Jew in the land, especially if he was of the tribe of Judah. Jesus Christ, being of this tribe, was undoubtedly in the succession, and had in him the blood of the son of Jesse. But then was there a man of the tribe of Judah at least who had not? Is there a man living now who has not? Of course the conventional value of Christ's descent by what is termed lineal succession from David, and its value as a fulfillment of prophecy on that ground, are independent of the generalizing proofs which would make out all to be David's children.

The evidence seems conclusive that Mary, the mother of Jesus, had several children after the birth of her illustrious First-born. He had brethren and sisters, and if some of these left posterity in the earth, as we may reasonably suppose they did, it is certain that we are the descendants, the children, of Mary, and have a kinship with Christ, much closer physically than we have dared to believe.

In his case the phrase "Son of man" had a unique significance, but the doctrine which has been expounded in this paper shows that it has a real and solemn significance to whomsoever applied. Each of us is "son of man" in the tremendous sense that he is descended from all the people who have posterity remaining, who lived on earth a few centuries ago. Every individual living before Christ who has descendants at all has them in us. We are the offspring of the whole of humanity

at that time. Every slave and every lord in the days of Julius Cæsar has contributed to our being, and, looking back to those times, each one may consider himself not the child of a thin, thread-like line of parentage, but child of the race, son of all mankind.

This subject has important bearings in the political realm. It invalidates the basis of hereditary monarchy, and shows that it rests upon a genealogical fiction. It is a depraved conventionalism, a custom born of falsehood and of wrong to single out the eldest child or any other child as the bearer of the honors and emoluments of the family to the exclusion of the rest. All the children are equally partakers of the parental nature. In the course of less than a thousand years the descendants of an illustrious sovereign get strangely dispersed, and his blood becomes mingled with the common reservoir of national life. Every marriage outside his family runs off with half of what remained of him in the succession. After being halved so often, the wearer of his name and title, the possessor of his power, needs much faith or much ignorance to believe that he is in any real sense the peculiar descendant having a claim in nature beyond millions more. If the sovereign is the descendant of William the Conqueror or of Alfred the Great, so are the subjects. On the ground of hereditary succession every man may claim to be king, and every woman to be queen.

Hereditary aristocratic titles have no foundation in nature. They are based upon deception and injustice, and at best are purely arbitary. The eldest son who takes the title is no more the child than the rest of the children. If any title is inherited it ought to be common to them all, and, if the titular inheritance continued, it would be common to all the population of the land in the course of a few ages. It is restricted to one channel of descent under the delusion that this is more direct and is somehow closer to the founder of the family than other channels. The restriction takes place by means of a wrong done to the rest in excluding them from that which is as much theirs by right of nature as his who actually enjoys it. There could be no hereditary aristocracy save by the ignorance and weakness of the community at large, who tolerate the presence of a few among them flaunting in their eyes and jingling on their ears the tokens of the general deprivation of a natural due.

The doctrine of the close kinship of the nation practically carried out would lead to a universal distribution of property. The verdict of society is that a man who has property should leave it to his children after making due provision for his wife for the remainder of her days. This is the general rule which the common judgment of mankind prescribes, leaving only a small margin for bequests outside the family circle. Entail in its present form and primogeniture are doomed to go, and only wait the hour and the man. Law has already relaxed the grasp of the eldest son on *personal* estate, and provides for its distribution. In France it compels an equal distribution of *real* estate among

all the children. Taking, then, the broad rule for granted that the possessions of the parents must pass in equal portions to the children, there is seen to be wanted some strict guard on what a man bequeaths so that it shall not be squandered by his heirs. We can best follow out the result in regard to possession in land. Entail should be placed on a natural basis and carried out on a broader scale, and it would become a mighty instrument for good and for raising the general condition of the people without taking away the stimulus to labor.

There is provision in nature for the nationalization of the land. As soon as all the direct descendants are treated as heirs, the fact that these rapidly multiply till they are coextensive with the nation shows that, if the property left at death by the present possessors be similarly extended, all the land of the country now in so few hands must eventually come into the possession of the whole nation, and that not by any act of confiscation, but by simply acknowledging fact and doing justice. It would not answer, however, to go on subdividing property endlessly down to yards and inches. A limit would have to be set to subdivision and to inheritance by means of it, and after a certain generation, where the descendants had already become scores or hundreds, or after a certain degree of tenuity in the property had been reached, so that the forfeiture of his share would be no particular loss to the individual heir, it would be necessary to annex the whole to the national estate, swiftly accumulating by similar processes. If this rule were universally acted upon, though a man's descendants would cease, say, in the fourth or fifth generation to be his heirs in particular, the little amount they forfeited in this way would be more than made up to them by the many other inheritances of which they would become heirs in common with the nation. The railways could be passed through the same process by the gradual distribution of shares. As far as practicable other property should be dealt with on the same principle. This would bring about a general diffusion of wealth now congested in a few hands, and bring it about, too, gradually and safely by the operation of the great natural law of heirship through successive generations.

Already we have extensive properties that are owned by the nation at large, such as the roads and canals, the post-offices and telegraphs, the board-schools and the Established Churches, the parks, free libraries, and Government buildings. The principle is in operation, and, if it had the wider sphere that heirship demands, there would be an immense lightening of the burdens which are pressing upon the people. Each individual would commence life at an advantage, a few steps up the ladder instead of being down quite in the ditch, as are the majority —poor and penniless, dependent for everything on the exertions of the present hour. The rent of the national property might, as has been recently advocated, go to the payment of the taxes imperial and local. It might answer for the necessary work of government, for the

expenses of army and navy, for the payment of interest on the national debt and its gradual liquidation, for the elementary education of the children, and for the maintenance of the aged. Though I have not read Mr. George's book, I understand that this is something like his proposal. If the yearly return of the national estate were ever found to far exceed the above requirements, it could be readily and safely disposed of by a yearly dividend, which would reverse the old tormenting order, and make the people the receivers instead of payers of taxes. It is hard to see how this moderate diffusion of property could be injurious to them. If the smaller equal inheritance would degrade them, the present holders of large estates must be in a very bad way.

That which a man has accumulated by his own exertions he has a sort of right to disperse and to squander if he choose; but that which the dead have left behind them should, as far as possible, have permanence stamped upon it, and be guarded by the state, so that it may be enjoyed by all the heirs in their turn. The savings of the present generation should enable the whole community in the next age to start from a higher level of power and comfort. The law of labor can never be abrogated, though its incidence might be very wisely extended. The inequality between the possessions of men can never be totally destroyed, but with immense advantage to the nation it might be decidedly lessened. The progress that has thus far taken place in the condition of the people has been the laying of successive strata of comforts and resources between them and the utter poverty in which their forefathers dwelt. The increase of wages, the lessening of the hours of labor, the manifold fruits of modern inventions, the accumulated treasures of knowledge which all may take without diminishing the store—such instances as these show a gradual enrichment of the people to the general advantage. Who shall say that the process has gone as far as it ought to go? What harm could ensue if the present burdens of taxation were done away, and if even every man were the recipient of a yearly income of a few pounds which no act of his could ever alienate?

The landless people of the present generation are undoubtedly proportionate heirs to all the landowners of the country living not many ages ago, if heirship be founded in nature. That all should have gone into so few hands, and the vast majority of the heirs have deen deprived, is a great and grievous wrong. Those who wish to continue the present arrangements, and would bitterly oppose their modification in the way here proposed as an injustice to the few who in future would otherwise come into possession, are willing to inflict injustice upon the many of the future who ought to come into possession.

The great possessions now enjoyed by particular individuals, and that have come down from distant times, are due to accumulated wrongs. One heir in the succession has been advantaged to the ex-

clusion of scores, and eventually of thousands and millions. That which in nature was as much theirs as his is now his alone. That which should have flowed in many channels, shallow, but sufficient to fertilize, has been carried in a single stream, deep and full, but comparatively useless—mostly wasted. Much of the waste is seen clearly and painfully enough in the profuse and extravagant style of living, where one consumes what would decently maintain a thousand. When the properties of the country are thus piled up on a foundation of gigantic wrong, it would be unreasonable to expect a full measure of national health and prosperity, or that it should be really well with the people.—*Nineteenth Century.*

SCIENCE IN ITS USEFUL APPLICATIONS.

By Dr. WILLIAM ODLING, F. R. S.

PRESIDENTIAL ADDRESS BEFORE THE INSTITUTE OF CHEMISTRY.*

BY the attainment of our incorporation by royal charter, in lieu of the articles of association by which we have, until now, been banded together, we become for the first time an officially recognized professional body, known officially to Government, and both to municipal and to other professional bodies. Further than this, we have had formal acknowledgment made of our fitness to be charged with certain public duties and responsibilities, and have established our claim to be intrusted with correlative rights and privileges. Our profession, the public utility and importance of which have, in this way, received at length so formal a recognition, is one that we may all of us feel a just pride in belonging to. It is not, indeed, with bated breath that we need speak of ourselves as professional chemists. Chemistry, indeed, as a branch of knowledge, pertains not alone to the student, but exists also for the practitioner, and still more for the public. Of exceptional interest as a subject of study, it is of scarcely less interest from its manifold practical applications, and as a contributor to the daily wants and enjoyments of the community, a community in which all are bound up with another, and are under obligation to render services to one another. Nowadays, the ever-extending and increasingly complex wants of the community create a greater and greater demand for what are known as professional services, and for

* The original Institute of Chemistry was organized in England in 1877, under the presidency of Dr. Frankland, its second president being Sir Frederick Abel. It was reorganized in 1885, and incorporated under the title of the "Institute of Chemistry of Great Britain and Ireland." The present president is Dr. Odling, who gave his inaugural address before the new organization November 6th, and which is here given, with omission of the preliminary part, which is chiefly of local English interest.

professional services of a kind and extent that can not be rendered by the parson, or the doctor, or the lawyer; or yet by the amateur engineer, or the amateur electrician, or the amateur chemist. It is the competent services of professional men, specially trained in their several departments, that are alone adequate, and are alone accordingly in request. To the trained professional chemist, as to other professional men, interests of occasionally enormous value are committed; and some notion of the consideration in which his work is held may be gathered from the extensive resort had everywhere to his services, even by the great departments of state and by the most renowned and important of municipal and other corporations.

Among Government Departments, the War Office, the Home Office, the Board of Trade, the Local Government Board, and the Board of Inland Revenue, have each their respective permanently attached staffs of professional chemists, with whom from time to time, in relation to special subjects of inquiry, other chemists of distinction are associated. Among corporations and public institutions of all sorts, the City of London, the Metropolitan Board of Works, most of the great provincial Corporations and Local Boards, the Royal Mint, the Houses of Parliament, the Elder Brethren of the Trinity House, the Thames Conservancy, the Royal Agricultural Society, the great Gas and Water Companies, the different Metropolitan Vestries and Local Boards, and many more such bodies, have recourse alike to the regular services of their permanently attached professional chemists, and to the supplementary services of various others among us whom they find it necessary to call into consultation from time to time. And of yet greater extent as a whole is the habitual resort that is had to the services of the professional chemists by mercantile and manufacturing firms and associations, engaged in almost every variety of commerce, manufacture, and industrial enterprise. Alike, then, by the great departments of state, and by commercial firms of world-wide renown, and by traders and producers occupying a less distinguished position, the multifarious services of the chemist are ever in request. And in respect to ourselves, by whom these services are rendered, from those of us occupying the leading positions in the profession, to the most humble individuals practicing in our ranks, we are all associated in a common work, and have all a common credit to maintain, and are all under mutual obligation to co-operate with and advance the interests of one another.

It would seem, however, from observations not unfrequently hazarded by some very superior persons, whose happy mission it is to put the rest of the world to rights, that there is something derogatory to the man of science in making his science subservient in any way to the requirements of his fellows, and thereby contributory to his own means for the support of himself and of those depending upon him. Now, on this not uncommon cant of the day, a little plain speaking would

seem to be very much wanted. While the investigation of nature and the interpretation of natural law are admittedly among the highest, as they are among the most delightful of human occupations, the right application of natural law to effect desirable objects is in itself a scarcely less worthy occupation; many of these objects being of paramount importance, and attainable only by the exercise of high scientific sagacity and skill, aided by a fertility of resource and a persistent elasticity of spirit, ready ever to cope with the successive novel difficulties found to be continually opposing themselves.

In this matter, as in so many others, the sense of proportion is but too often lost sight of. Because the investigations of a Newton, a Darwin, a Dalton, a Joule, and a Faraday have an importance of which few among us can adequately conceive even the measurement; because among the scientific men now or but lately living in our midst are to be found those whose investigations in pure science have not only won for them a high renown, but have earned for them the gratitude, and should have obtained for them the substantial acknowledgments of their country and the world; and because even the minor investigations and discoveries that are ever being made in pure science have all of them their merit and their value, it does not follow that the mere accomplishment, it may be in an abundant leisure, of two or three minor investigations, however creditably conducted, are to lift their authors into a scientific position, altogether above that of men whose laborious lives have been spent in rendering their great scientific attainments directly serviceable to the needs of the state and of the community. The accomplishment of such like investigations does not entitle their authors to claim exemption from the duty of earning their own livelihoods, or give them a claim to be endowed by the contributions of others with the means to jog leisurely along, without responsibilities and without anxieties, the far from thorny paths of their own predilection. However heterodox it may be thought by some, the best of all endowments for research is unquestionably that with which the searcher, relying on his own energies, succeeds in endowing himself. The work to which our natures are repugnant, not less than the work which entrances us and hardly makes itself felt as a work at all, has to be done. In some degree or other, we have most of us to obtain our own livelihood; and harsh as may seem the requirement, it will, I suppose, be conceded that the necessity put upon the mass of mankind, of having to earn their daily bread, is an arrangement of Providence which has, on the whole, worked fairly well; and further, that the various arrangements hitherto tried for exempting certain classes of men from the necessity of having to earn their daily bread, in order that they might give themselves up to the higher spiritual or intellectual life, have scarcely, to say the least of them, worked quite so satisfactorily as they were intended to. All of us are, without doubt, qualified for higher things than the mere earning

of our daily bread; but the discipline of having to earn our daily bread is, in more ways than one, a very wholesome discipline for the mass of us, and even for the best of us. It may here and there press hardly on particular natures, but it is rarely an impediment to the achievement of the highest things by those having the moral qualities, the judgment, the determination, and the self-denial necessary above everything else for their achievement. Not a few of us may consider ourselves fitted for higher work than the gods provide for us, and fondly imagine what great things we should effect if we could only have our daily bread supplied to us by the exertions and endowments of other less gifted mortals. But experience is not on the whole favorable to the view that, the conditions being provided, the expectation would be realized. Experience, indeed, rather favors the notion that it is primarily the necessity for work, and association with those under a necessity to work—those in whom a professional spirit has been aroused, and by whom work is held in honor—that creates and keeps up the taste and the habit of work, whereby the vague ambition to achieve is turned to some productive account. Take, say, a thousand of the most eminent men the world has produced, and, making no allowance for the large influence of descent or training, or of association with those to whom work is a necessity, or, having been a necessity, has become a habit, consider what proportion of these men have, by their means and position in early life, been free from any stimulus or obligation to exert and cultivate their powers; and consider, on the other hand, what proportion of them have been stimulated to exertion and success by the stern necessity of having either to achieve their own careers, or to drop into insignificance, if not indeed into actual or comparative degradation and poverty. We ought, indeed, all of us to be students, and to be above all things students; but the most of us can not be, nor is it desirable, save in the case of a special few, that we should be only students. We have all our duties to fulfill in this world, and it is not the least of these duties to render ourselves independent of support from others, and able ourselves to afford support to those depending upon us. Fortunate are we in being able to find our means of support in the demand that exists for the applications of a science which has for its cultivators so great a charm. To judge, however, not indeed by their coyness when exposed to the occasional temptation of professional work, but rather by their observations on the career of others, the most sought after and highest in professional repute, the pursuit of professional chemistry is, in the opinion of some among us, a vocation open to the gravest of censure. It is praiseworthy, indeed, for the man of science to contribute to his means of livelihood by the dreary work of conducting examinations in elementary science for all sorts of examining-boards, and by teaching elementary science at schools and colleges, and by giving popular expositions of science at public institutions, and by exchanging a minor

professorial appointment, affording abundant opportunities for original work, in favor of a more lucrative and exacting appointment involving duties which, if rightly fulfilled, must seriously curtail these same opportunities. It is praiseworthy of him to add to his means by compiling manuals of elementary science, and by writing attractive works on science for the delectation of general readers; but it is forsooth derogatory to him, if not indeed a downright prostitution of his science, that he should contribute to his means of livelihood by making his knowledge subservient to the wants of departments, corporations, and individuals, alike of great and small distinction, standing seriously in need of the special scientific services that he is able to render them.

A glance back suffices to show how foreign to the ideas of the great men who preceded us is this modern notion of any reprehensibility attaching to applied or professional science. In his earlier days, Professor Faraday was largely employed in connection with all sorts of practical questions, and until almost the close of his life continued to act as scientific adviser to the Trinity House. No man was more constantly occupied in advising with regard to manufacturing and metallurgic and fiscal questions than Professor Graham, who ended his days holding the official position of Master of the Mint; a position in which he succeeded another eminent man of science, less known, however, as a chemist than as an astronomer, Sir John Herschel. As in these typical instances, so also in very many others; and, if I may be allowed to draw at all on my own personal experiences, I would say that some of the most pleasant remembrances of my past life relate to the occasions on which I had the good fortune, early in my career, to be brought into association, as a junior professional colleague, with some among the then most eminent of scientific men. It did not indeed happen to me to be associated in this particular manner with Faraday, or Graham, or Daniel, or yet with their frequent colleague, Richard Phillips, one of the early Presidents of the Chemical Society, for many years the able and omniscient editor of the "Philosophical Magazine," and the leading professional chemist of his day. But among those who have passed away from us altogether, or have for some cause or another quitted our ranks, my recollection goes back to professional association with a host of distinguished men of science, whose membership would, of itself, suffice to insure an honorable estimation for any profession to which they belonged. On different occasions it has been my lot to be engaged in advising on various questions in conjunction with Arthur Aikin, a personal friend of Priestley, writer of a still valuable dictionary of chemistry, the first Treasurer of the Chemical Society, and for many years the leading authority in regard to chemical metallurgy; with Dr. Thomas Anderson, of Glasgow, an assiduous and successful worker in the then unfamiliar field of organic chemistry, and for many years consulting chemist to the Highland

Society; with Professor Brande, the pupil and successor of Davy, at the Royal Institution, long time one of the Secretaries of the Royal Society, an early President of the Chemical Society, and, in his professional capacity, Director of the Die Department at the Royal Mint; with Sir Robert Christison, of Edinburgh, one of the most scientific of British toxicologists and pharmacologists, an original worker in many fields of inquiry, President of the Royal Society of Edinburgh, and a selected, though not an actual, President of the British Association; with Dr. Warren de la Rue, the friend of us all, more than once President of the Chemical Society, and a Vice-President, Medalist, and Bakerian Lecturer of the Royal Society; with Dr. Hofmann, the first Professor at the College of Chemistry, and Assayer for many years to the Mint, one who can claim so many of us as his pupils, and who, as a professional chemist, no less than as an investigator and teacher, ever set an example of energy and vivacity to all his associates, working on one occasion the long night through in order to extract from paraffine-oil a specimen of benzene, ready for exhibition in court on the following morning, an instance of professional devotion which, as the presence of my immediate predecessor, Sir Frederick Abel, reminds me, is not wholly without a parallel. Proceeding in my enumeration, I may mention Sir Robert Kane, then of Cork, a teacher and worker of originality and wide erudition, to whom chemists are indebted for their now familiar conception of amidogen; also Dr. Allen Miller, Professor at King's College, London, and Assayer to the Mint, a President of the Chemical Society, and for many years Treasurer of the Royal Society; also Sir Lyon Playfair, then Professor of Chemistry at the University of Edinburgh, now a member of her Majesty's Privy Council and President of the British Association, one to whom we are indebted for his hearty sympathy with the objects of the Institute, and for the unsparing exercise of his efforts and influence on our behalf; also my relative by marriage, Alfred Smee, a pioneer in electro-metallurgy, and inventor of the galvanic battery by which for the third of a century the greater part of the galvano-plastic work of this country has been effected; and lastly, Robert Warington, chemist for many years to the Society of Apothecaries, the founder and first Secretary of the Chemical Society, and a frequent contributor thereto of his characteristically ingenious observations. And not only with the above-named eminent men of science, but with many others also, has it been my fortune to be professionally associated, including, I regretfully have to add among those who have passed away from us, some of the most distinguished original members and warmest friends of the Institute, as Dr. Stenhouse, Sir William Siemens, Professor Way, Dr. Angus Smith, Dr. Voelcker, and Mr. Walter Weldon. Moreover, among the leading men of science of the present day, Sir Frederick Abel, Mr. Crookes, Professor Dewar, Professor Frankland, Mr. Vernon Harcourt, Dr. Tyndall, and Dr. Williamson, are either the holders of

definite professional appointments or are otherwise more or less actively engaged in the work of the professional chemist. A profession surely stands in need of no apology which includes and has included in its ranks, within such a limited period, such a host of distinguished members.

So far, moreover, from his professional eminence and usefulness being made a matter of reproach to the scientific man, it should constitute rightly a claim to his higher consideration; and, far from being accounted a disparagement, should be held as an addition to his scientific standing. In the professions most allied to our own on the one side and on the other, this is well recognized. The physician and the engineer are not merely students of pathology and of mechanics, however important may have been their contributions to pathology and mechanics respectively, but they are the distinguished craftsmen in their respective arts. And, whether or not they may have made important contributions to pure science, their rank as eminent scientific men is everywhere and rightly conceded to them. A lucky chance happening to any professional man may indeed bring him to the front, but no succession of lucky chances can ever happen that will of themselves prove adequate to keeping him there. Great qualities are ever necessary to sustain great professional positions; and to be for years one of the foremost in a scientific profession is of itself at least as substantial an evidence of scientific attainment as is the publication of a memoir on some minute point, say of anatomy, or chemistry, or hydrodynamics, for example. And it is so recognized, and very properly recognized, even in quarters where pure science admittedly reigns supreme. Leading engineers and leading physicians and surgeons are every year admitted into the Royal Society, not on account of the importance attaching to any special contributions they may have made to mechanical or pathological science, but mainly because of their eminence in their several professions, in which to be eminent is of itself an evidence of scientific character and of extensive scientific knowledge. It may indeed be taken as beyond question that, to obtain and retain a leading position in a scientific profession needs, among other things, the possession of high scientific attainments. I say among other things, for without moral qualities in a notable degree, sympathy, endurance, courage, judgment, and good faith, no such professional success is conceivable. Professional eminence is the expression necessarily of scientific ability, but not of scientific ability alone. The self-engrossing science of the student has to be humanized by its association with the cares and wants, and the disappointments and successes, of an outside world.—*Chemical News.*

THE PHYSIOLOGY OF THE FEET.

By T. S. ELLIS, M. R. C. S.

DISREGARDING the action of those parts not affecting the feet, the act of walking may, as I think, be thus described: The foot put forward should reach the ground when nearly flat; the toes, the organs of feeling, should be the first to reach it, not the heel, which could not be without some concussion, however slight. The heads of the metatarsal bones and the toes are then pressed firmly against the surface. The great-toe, having only two phalanges, is held down in its whole length, the flexor tendon being attached to the final phalanx close to the joint between them. The little toes touch at their tips only; their flexor tendons being also attached to the final phalanx of each, traction on them causes a rising at the joint between the two proximal phalanges as the tips of the toes are drawn backward. By this arrangement, in the one case a firm, solid base is formed from which the body can be propelled onward; in the other an additional hold on the surface, by a rudimentary action or grasping, is afforded. As the body is moved onward, the extensors of the great and of the little toes, without lifting them from the ground, where they are held by the flexors, draw the leg forward, while the anterior tibial, in assisting this movement, serves another purpose. It is attached to the crown of the arch, and in action tends to prevent any sinking there as the weight of the body comes upon that structure. This purpose is much more effectually served in another way: the muscles of the calf allow the heel with firmness and precision, but withal gently, to touch the ground, and the step is completed.

The heel is then raised, but the weight of the body is not borne, as commonly stated, by the muscles acting on the heel and by them only: the deeper muscles, the posterior tibial with the long flexors and the long peroneal, acting round the inner and outer side of the ankle respectively, all of them assist in raising the body and at the same time have a most important influence in maintaining the arch. The tibialis posticus, attached by its expanded tendon to the tarsus on the under surface beyond the astragalus, the bone on which the weight of the body rests, materially assists in supporting the arch from below. The long flexors passing beneath the arch from one abutment to the other are, in relation to it, as bowstrings to a bow, or rather, as the two tendons cross each other, they may better be compared to the tie-rods of a roof.

This arrangement of the two tendons crossing each other is very curious: that going to the great-toe is lowest in passing round the ankle, in order to be, as nearly as possible, at the extremity of the

arch or bow at that end, as it is at the opposite one; if, however, it passed directly across the sole from end to end there would be little if any free space beneath, but, being crossed by the flexor longus digitorum, which comes round the ankle at a higher level, it is so drawn up that a hollow beneath the arch is formed; the flexor accessorius, by drawing back the tendon of the flexor longus pollicis, compels it to cross the other nearer to the heel, and so increases this effect. Thus the flexor longus pollicis, regarded as the chord of the arc, becomes itself an arc.

The tendency to inversion which all these muscles, acting from the inner side of the ankle, might occasion is corrected by the long peroneal on the outer side; it also, acting on the base of the first metatarsal bone, a point considerably beyond the center of gravity, has a bracing action on the arch, as the weight of the body falls upon it. In this, too, no doubt the small muscles of the sole assist those of the calf, but I can not accept the converse statement that it is the "muscles of the sole assisted by the tibial muscles" which "are the active agents." The deep muscles of the calf have much the more potent influence. Thus it is that by the action of muscles the whole of the strain which the weight of the body in walking would otherwise throw on the ligaments binding the arch together is removed, and any tendency to flattening of it prevented.

This, which has been called my "bowstring theory," is the view I put forward in a little monograph, "On the Arch of the Foot," written and printed in 1877. For reasons therein given I could not accept the view that the arch is maintained by ligaments, or believe in the carriage-spring movement of those ligaments, yielding to the weight of the body, as the explanation of a springy gait. It is really due to the heel being gently lowered and firmly raised. Upon this the grace of walking depends. On the same grounds I hold that in proper walking the foot does not lengthen. Camper, whose treatise is regarded as classical, but which, as I think, contains many important errors of fact and of induction, said that his knowledge of anatomy taught him that it did so. On the contrary, I believe that as the tightening of a bowstring approximates the ends of the bow, so the bowstring action of the flexor muscles on the arch of the foot tends to shorten it. If walking were a succession of standings, flat-footed alternately on either foot, no doubt there would be lengthening, as the ligaments of the arch yielded. Such a mode of progression is, we know, possible; and, indeed, we sometimes see something like it, hardly, however, to be called walking. I would ask those who believe that the foot in walking lengthens "one tenth of its length, or about an inch" (a statement on high authority made during the past year), to consider this: What, then, would be the condition of the sole, after a long walk, from friction caused by the necessary sliding with the weight of a man borne upon it? As in every mile of the ordinary march of soldiers more

than a thousand steps are taken on each foot, the result would not be pleasant even to imagine.

The position of the foot is important. To turn out the toes seems to me to be not only untrue to nature, but objectionable as well as inelegant. Camper regarded it as incontestably the proper position. For the following reasons I believe that the toes should be directed forward, the inner margins of the feet parallel: It is desirable that the propulsion of the body onward from, and consequent thrust backward on, the foot, and especially on the great-toe, should be in the direction of its length rather than obliquely across it, not only as giving a firmer bearing from which to propel the body onward, but as diminishing the friction on the sole and consequent tendency to foot-sore. This applies also to the smaller toes in a less degree. The long axes of all the toes continued backward seem to converge on the heel. By standing with the bare foot and springing forward it can readily be seen how much more tendency there is to slide on the sole when the foot is turned out than when it is directed forward. In the latter position, too, the arch is much more firmly braced up—a fact recognized by surgeons who advise, in cases of flat-foot, that the toes should be directed inward rather than outward. In standing, the everted position is not more stable. When a body stands on four points I know of no reason why it should stand more firmly if those points be unequally disposed. The tendency to fall forward would seem to be even increased by widening the distance between the points in front, and it is in this direction that falls most commonly occur.

Those who look on the human foot as fully partaking of the beauty of which artists in every age have regarded the human body to be the highest expression, ought not readily to admit that the boot which best conforms to its outline, reveals its features, and expresses its leading characteristics, will require an apology for want of elegance. I, at any rate, can not admit anything of the kind. The human foot is, moreover, an object of far more than the ordinary interest belonging to every part of the human structure. In the monograph already mentioned I ventured to suggest that, anatomically, there is no more marked distinction between man and the lower animals than is to be found in the special development of the foot.

However much we may regard it as in itself calling for admiration on account of its fitness for the purposes it has to fulfill and for others it may on occasion serve, the human foot is far more remarkable as an adaptation of the mammalian type, modified to suit a purpose kindred to but differing from that which the corresponding member supplies in other animals. The heel has its special form and significance in that man only has one adapted for crushing an offensive object beneath it. The large size and important function of the great-toe is also a specially human feature. In the mammalian typical limbs the bones of the hand and foot (or rather, to avoid confusion, in four-handed or four-

footed animals, *manus* and *pes*) are arranged on a uniform plan: to each five digits, the first having two phalanges and the others three. The first digit is generally attenuated, often suppressed, but whenever it exists it has two phalanges only.

This curious difference is nowhere, so far as I know, explained. I can not discover that any animal (below man), recent or fossil, exists or has existed from the times of the Trias formations till now in which this arrangement has appeared to be essential. It may be of some advantage in the quadrumana, and doubtless the human hand is thus better fitted for its functions, but it seems to me to be much more difficult to imagine it possible for any other arrangement to exist in the foot unless the whole scheme of it, so to speak, were changed. It is essential that the only joint in the great-toe should be drawn to the ground by the strong flexor tendon attached to the final phalanx close to it; if another joint existed it must rise up, as occurs in the other toes, and the solid bearing would be lost. Apart from this, it must be admitted that it is mainly due to the special development of the great-toe in a line with the long axis of the foot that man is enabled to exercise the attribute, in all ages regarded as a noble one, of standing erect. Yet this special feature is the one which the conventional boot does most to conceal, and in direct proportion as it is successfully concealed the wearer is supposed to be dressed in good taste. It would seem to be regarded as necessary to reduce the foot to even-sided symmetry; but there is no law of beauty which requires this. Mr. Ruskin assuredly would not say that it is in any of "the eternal canons of loveliness" decreed that an object to be beautiful must be symmetrical. An architect required to provide more space on one than on the other side of a building would not seek to conceal or even to minimize the difference; he would seek rather to accentuate it, and give the two sides of the structure distinctive features. To me it appears that it is on this principle only that a boot, to be at once useful, graceful, and appropriate, can be designed.

Moreover, the sense of symmetry, natural and reasonable where the same function has to be performed, is, or ought to be, satisfied by the exact correspondence of the two feet, which, taken jointly, may be described as the two halves of an unequally expanded dome, irregularly extended at the base, the greatest extension being in the line of the greatest expansion of the dome, through which line the division runs. The dividing-line thus makes the margin of the two feet parallel to each other. It may be that the inner margin of the great-toe, if produced backward, would fall a little distance from the inner side of the heel. A perfect adult foot, in which the great-toe is not and never has been diverted outward, and in which there has been no consequent thickening of the large joint, is not easy to find. In children the inner line is often visibly concave. It may be remarked that in rest the great-toe is everted as well as drawn upward, in which posi-

tion the toes are usually packed in a tight, medium-pointed boot; it is only therefore in action as the toes are pressed against the ground that the full extent of the approximation to a straight inner line is seen.

In the boot it is of first importance that the sole (technically, the part in front of the hollow or "waist") should allow the great-toe to occupy its natural position; it must, therefore, be straight, or nearly so, on the inner margin; but it is of little use to provide the room thus given unless it be occupied; the foot must be invited to occupy it by giving plenty of room in the upper leather on this side. It is obvious that where a flexible material is fixed on both sides and left loose between, it can be drawn farthest from the surface to which it is attached, in a line midway between the fixed parts. For this reason the highest part of the foot, which is on the inner side, will, in any case, have some tendency to go to the middle line of the boot where most room can be made; this tendency is largely and needlessly aggravated by the high ridge of the last being along the middle line instead of being on the inner margin. But not only ought the room there given to be much more according as the foot projects the more upward; it ought to be proportionally more. I have insisted that the foot does not lengthen in walking, but rather shortens. This shortening, due to the powerful action of the long flexors, causes the foot to rise across the middle, the rising being almost entirely on the inner side. Here, therefore, over (not by the side of) the ball of the great-toe is special room required. The lateral thrust, too, already spoken of as consequent on turning out the toes, tends much to displace the foot and to throw it against the outside of the boot. Toe-caps also are objectionable, as giving the most room in the middle line and inviting the great-toe to occupy that position.

No useful or ornamental purpose is served by leaving space unoccupied round the outer margin of the sole opposite the little toes, as if it were necessary to make the two sides of the boot to match. No angle existing in nature, none should be represented; the outline of the sole of the boot should conform to that of the foot.

If it be true, as already stated, that grace in walking, as well as free propulsion of the body onward, and maintenance of the arch in walking, are all due to the free action of the flexor muscles, letting the heel down with gentleness and precision, and raising it with firmness and vigor, it follows that none of these can be if the boot prevent the heel from going down, a necessary antecedent to springing up. A low heel, therefore, if any, is imperative. The perfect boot should have none. Nor can the free action of the flexor muscles have full effect, so as to draw the toes to the ground, if the sole be turned up at the toes, especially if it be a stiff one. Some turning up will come from walking, however good, but there is no reason why it should be aggravated by having the boot-last so. In it the sole should be flat to the end.

Objection is made that boots with a straight, or nearly straight, inside line give the feet a pigeon-toed or inverted appearance, which is unnatural. This is not altogether due to the eye being accustomed to a more conventional pattern. It is, I am sure, mainly due to a removable cause. Any conspicuous line, that of the laces or a seam, is always carried from the front of the leg to a central point on the upper surface of the foot. The eye, falling on this line, in imagination continues or produces it, and so divides the front part diagonally into two very unequal portions, the larger on the inner side. I have found that if the line of the laces or seam be kept parallel throughout to the line of the long extensor tendon—in other words, along the crest of the ridge, thus marking out a distinctive feature—the unpleasant effect is removed.

In proper walking, which can not be done in an improper boot, friction of the foot on the sole and of the latter on the ground is reduced to a minimum, the sole being pressed against, not rubbed along, the surface. This is shown by the very little wearing of the leather; when at last it does give way, it should be at an oval spot a little distance from the margin of the sole, under the middle joint of the great-toe. This is the last point to leave the ground in walking; here, therefore, is the greatest tendency to slide on the surface and consequent friction.

The great-toe, in any but the most perfect feet now to be found, is so easily diverted outward that socks and stockings with a straight inner line are very desirable; indeed, no others can be said to really fit the feet. When any considerable distortion exists, a separate stall for the great-toe is necessary.

For the reasons given, a last should have the inner margin nearly in a line with the inner side of the heel, and joining in front by a rounded angle a long curve on the outer margin, where no angle should be shown. The sole should be flat, touching the base-line in front. The thickest part (highest vertically) should throughout be on the inner margin, especially above the ball of the great-toe. The boots should have low heels—to be perfect, none. The line of laces or of any conspicuous seam down the front should be in a line corresponding with the inner margin of the foot along the highest part. The boot should, if possible, be left on the last for a considerable time, to overcome the tendency of the leather to recoil after the forcible stretching to which it has been subjected, and so to fix it in its proper shape.—*Lancet.*

SKETCH OF FRANK BUCKLAND.

FRANCIS TREVELYAN BUCKLAND, who was almost universally known as Frank Buckland, was the eldest son of Canon William Buckland, of Christ Church Cathedral, Oxford, afterward Dean of Westminster, and author of the "Buckland Bridgewater Treatise," and was born in Oxford, December 17, 1826. He attended school at Cotterstock, in Northamptonshire, and spent two years with his uncle, the Rev. John Buckland, at Laleham School, near Chertsey; attended Winchester College, where Dr. Moberley, afterward Bishop of Salisbury, was head-master, from 1839 to 1844; and in the latter year entered Christ Church College, Oxford, where he took his bachelor's degree in 1848. He then entered upon the study of surgery at St. George's Hospital; passed the College of Surgeons in 1851; and became house-surgeon at that institution in May, 1852. In 1854 he was gazetted assistant-surgeon to the Second Life-Guards. In 1860 he applied for promotion to a full surgeoncy; but a rule was adopted, different from the old tradition of the Guards, that medical officers should be promoted as vacancies occurred in the same regiment, by which promotion was made to go by seniority in the brigade or at the discretion of the colonel; and the preference was given to an assistant-surgeon of older standing from another regiment. Disappointed by this action, and encouraged by the growing success of his literary and scientific career, Buckland resigned his commission in 1863, and devoted himself with ardor to what was to be his life-work in natural history and literature. "Fish-culture was henceforward his chief pursuit, and his life became one of incessant activity, bodily and mental"; but every fact connected with nature was interesting to him, and was held worthy to be communicated to others. He had begun to write in 1852, for periodicals, those articles which were afterward published collectively in his "Curiosities of Natural History." In 1866 a third series of this work was published, and Buckland, associated with some friends, started the periodical "Land and Water," of which he was the inspiring genius till the time of his death. In 1867 he was appointed one of the two Inspectors of Fisheries for England and Wales, succeeding Mr. Frederick Eden, one of the inspectors originally appointed under the Salmon-Fisheries Act of 1861. This position he held and worked in for the remainder of his life He shunned no exposure in the execution of his favorite pursuits, but rather courted it, and professed to enjoy getting wet, whether by being rained upon, or by wading up to his neck in water while searching for eggs. Too many of these exposures, and carelessness in indulging in them, brought on the illness which proved fatal to him. He died, of disease which had begun with an inflammation of the lungs nearly two years before, on the 19th of December, 1880.

Such is a skeleton chronology of a life than which none more active, varied, and useful, is recorded in scientific biography. For the story of the lives of many men of science we have to be satisfied with a skeleton almost as meager as this; but happily that is not the case with Frank Buckland. He has, in the papers constituting his "Curiosities," and in "Land and Water," so revealed himself in his inner life, with his thoughts, feelings, and purposes, and his friends and the brother-in-law who has prepared his biography have given such vivid descriptions of him as they saw him, that the man is made to stand out before us almost as in his very life and personality.

From these sources we learn that, when weighed shortly after his birth, the infant Frank was found to be heavier than the leg of mutton provided for the family dinner of that day; and that a birch-tree was planted in honor of his arrival, the taste of the twigs of which he learned to know well. His early years, as described in his mother's journal, reflected in miniature his character in maturer life. For facts, especially of natural history, he had from childhood a most tenacious memory. At four years of age he began collecting specimens, and at seven he commenced a journal. Earlier than this, at two and a half years of age, "he would have gone through all the natural history books in the Radcliffe Library without making an error in miscalling a parrot, a duck, a kingfisher, an owl, or a vulture." When he was four years old a clergyman brought to Dr. Buckland, from a considerable distance, some "very curious fossils." They were shown to the child, who, not yet able to speak plainly, said, "They are the vertebræ of an ichthyosaurus." At three years of age his mother could get him to learn nothing by rote. His mind was always at work on what he saw, and he was very impatient of doing that which was not manifest to his senses, yet he was not considered premature. He excelled in apparently strong reasoning powers, and a most tenacious memory as to facts. He was always asking questions, and never forgot the answers he received, if they were such as he could comprehend. And he was always wanting to see everything done, or to know how it was done; and was never happy unless he could see the relation between cause and effect.

It was not surprising, as Buckland's biographer remarks, that his love of nature should grow with his growth, for it was inherited from both parents, and was encouraged by every association of his youth. "In his early home at Christ Church, besides the stuffed creatures which shared the hall with the rocking-horse, there were cages full of snakes, and of green frogs, in the dining-room, where the sideboard groaned under successive layers of fossils, and the candles stood on ichthyosauri's vertebræ. Guinea-pigs were often running over the table. In the stable-yard and large wood-house were the fox, rabbits, Guinea-pigs, and ferrets, hawks, and owls, the magpie, and the jackdaw, besides dogs, cats, and poultry, and in the garden were the tortoise

(on whose back the children would stand to try its strength), and toads immured in various pots, to test the truth of their supposed life in rock-cells." Then there were the visits to the museum, and the afternoon drives, with which the hunt for some natural object was usually associated.

At Winchester, he was known as "a boy utterly indifferent to personal appearance, but good-tempered and eccentric, with a small museum in his sleeve or cupboard," an expert hand in skinning badgers, rats, etc., "and also setting wires at Blue Gate, for cats." A schoolfellow who slept in the next bed to him used to observe him "to get up in the middle of the night, and designedly in half-darkness carefully bind two fagot sticks together, for the purpose, as he said, of accustoming himself to be called up as a surgeon, half asleep, to do some professional duty under adverse circumstances." So we may follow him during his four years at this school, extracting the poison-fangs from adders, dissecting cats, and even successfully attempting the eye of the warden's dead mastiff. With his good-humor and spirits and his uniform amiability and obligingness, he became the most popular boy in the school. "Fond of school-work he was not, but he did his duty fairly, got through his 'construes' somehow, and ground the regulation grist of dreary Greek and Latin verse. Neither did he care for games." Toward the end of his school-days his anatomical studies enlarged their scope, and he undertook fragments of humanity, which he obtained secretly from the hospital and secretly dissected.

Of his life at Oxford, Dr. Liddon observes that there hung an odor of physical science about his rooms, "which increased as you got nearer. If you passed through the outer room into the study, you found the occupant surrounded by friends and playmates, irrational or human, and deep in scientific investigation after his own fashion, which, be it observed, was as industrious as it was irregular." His fellows did not then appreciate the reality or value of the work he was engaged in, "or that he was in fact educating himself much better than most of us were doing." Here we find a friend visiting him at his rooms having to tuck up his legs on the sofa to keep the jackal, which is prowling about the room, from biting them, while the jackal feasts himself upon the Guinea-pigs under the sofa; and we are introduced to Tiglath-pileser, or Tig, the pet bear, who attracted the notice of the British Association in 1846 as a guest in cap and gown at the garden-party, where he was introduced to Sir Charles Lyell, Prince Canino, Milne-Edwards, and Sir T. Acland, and was mesmerized by Lord Houghton.

Buckland's first article was published in 1852, after the author had attempted an unsuccessful paper on the muscles of the arm. Mr. White Cooper, the Queen's oculist, called at the deanery, and was invited down-stairs to see the pet rats. Frank took them out of the cage one by one, and described in a most interesting way the habits and

peculiarities of each. Mr. Cooper then suggested to him to put down on paper all that he had related, for publication. Frank demurred, because he did not think he could write anything worth reading, but finally produced the article, which was published in "Bentley's Miscellany." This was the beginning of the series which were afterward collected and published as "Curiosities of Natural History."

He gave his first lecture in December, 1853. It was delivered at a working-men's coffee-house and institute, and was on the human body, or "The House we live in." Of his qualities as a lecturer we are told that "he inherited from his father the faculty of investing a subject, dry in other hands, with a vivid and picturesque interest, and to this he added a variety of subject and a fund of droll yet apt illustration peculiarly his own. 'I can't get on,' he used to say, 'until I make them laugh; then we are all right.' His drollery was irresistible, yet was always informing; while his vehement earnestness, and alternation of the serious with the humorous, never failed to arrest attention."

Two or three years after entering the Life-Guards, it occurred to Buckland that he was "getting too much in the natural history line," and must give more attention to medical subjects. He did not, however, but went deeper and deeper, and with more and more interest, into natural history; and his life in this period was full of his observations and experiments and collecting, and the writing of those charming articles for the periodicals. He began to write regularly for the "Field" newspaper in 1856, and continued to do so till 1865, or shortly before he started "Land and Water." He prepared a new edition of his father's "Bridgewater Treatise," receiving valuable aid in the work from Professor Owen and Professor Quekett, the former of whom looked upon it as "the best elementary book that a country gentleman or azure lady could take up" for the sciences of geology and paleontology. It was framed, says Mr. Bompas, Buckland's biographer, "on such broad lines as to be of permanent value, notwithstanding the time which has passed since it was written, and the rapid expansion of geological science."

The year 1859 was distinguished for Buckland by the search which he prosecuted in person for fourteen days, in the vaults of St. Martin's-in-the-Fields, for the body of John Hunter, the father of modern physiology, which he found at last on the 22d of February. He took his friends down to see it, including Professor Owen, who expressed himself much pleased. "I wish I could have made a sketch of him," he writes, "with his hand on the coffin, looking thoughtfully at it; it would have made an excellent subject." The coffin was afterward reinterred in Westminster Abbey. In the same year, the idea, carried out somewhat later, of forming the Acclimatization Society, was suggested to him after eating a dinner of eland or African antelope.

Immediately after leaving the Life-Guards he threw all his energy into the promotion of fish-culture; and his diary is full of the records

of his experiments in hatching, of consultation, and of the giving of instructions to others who had become interested in the enterprise. He showed his apparatus and explained it at the exhibitions. He lectured at the Royal Institution on the subject, and gave the grave members of that body the novel experience of laughing at the racy humor with which the new science was explained, "while the earnestness with which the national importance of the subject was enforced was none the less impressive." The substance of this lecture was afterward expanded into a book on "Fish-hatching." He was invited up into Ireland to see what was the matter with some salmon-fisheries in Galway. Seeing a very fine salmon-ladder, he climbed down into it and imagined himself a salmon, congratulating himself on narrow escapes from the nets and crevices below, and thinking how very desirable it would be to get up to his autumn quarters in Lough Corrib. To preserve and make popularly visible the results of his investigations into fish-breeding, he made the series of casts of the roe of fish and of the forms of fish at different stages of growth, which is exhibited at the South Kensington Museum. He next studied oyster-culture, and gave lectures, scientific and popular, on that. These occupations prepared the way for his appointment as Fish Commissioner, and rendered it the most appropriate one that the Government could make.

In studying the problem of fish-passes for salmon, to which he gave a great deal of attention, he made it a principle to enter, so far as was possible to man, into the feelings of a salmon, as he did at the Galway ladder; and so thoroughly did he carry out the principle that he became "as an inspector almost amphibious, wading the pools below the weirs, and feeling the force and direction of the current. . . . No wonder, then, when it was publicly stated that, in his evidence before the House of Commons, he had leaned rather to the interest of the millers than of the salmon-fisheries, he protested that his statements had either been misconstrued or not understood. 'Having placed myself as a shield over the salmon interests, I have, as is the fate of shields, received most of the arrows.'" With regard to the cultivation of the English rivers, he saw that the conflicting interests could be reconciled without injury to any; and he strove unceasingly, and with no little success, to propagate the belief among all classes that they were each and all interested in the preservation of salmon. He continually lifted up his voice against the pollution of rivers, and told the people of Gloucester that the Chinese, who use everything in the way of manure, call the English barbarians because they pour their sewage into the rivers. The beginning of the illness from which Mr. Buckland died dates from January, 1879, when he was attacked with inflammation of the lungs after having been engaged in packing eggs from Australia in the ice-house of the steamship Durham. He was again attacked in November of the same year, after exposure in a violent snow-storm following the last inquiry it was his privilege to hold,

among the fishermen at Cromer. His last fishery report was presented in March, 1880. It was a document which he endeavored to make as far as possible an outline and guide to those who wish to open up and improve salmon-fisheries, in whatever part of the world they may be situated. He went for the last time to the fishery-office in August, 1880, and left his house for the last time, on the 21st of the same month, to visit a newly arrived orang-outang. He continued to write, however, for "Land and Water," and completed a new edition of the "Natural History of British Fishes," and a revised edition of White's "Natural History of Selborne" in the last month of his life. He also arranged and revised a series of articles, which was published after his death, as "Notes and Jottings from Animal Life."

Buckland's journals occasionally show glimpses of those thoughts and feelings that men do not usually talk much about to others; the passages strikingly exhibit his simple-hearted earnestness. Thus, in 1865, he says: "I can not help thinking that the Almighty God has given me great powers, both of thought and of expressing those thoughts. Thanks to him, but I must cultivate my mind by diligent study, careful reflection in private, and quick apprehension of facts out-of-doors, combined with quick appreciation of ideas of others; in fact, strive to become a master-mind, and thus able to influence others of weaker minds, whose shortcomings I must forgive. . . . Why should I not imitate the example of that great and illustrious man to whom I owe so much of my education (William of Wykeham, founder of the Winchester School), and endeavor to do as much good as possible in my humble way? I will therefore begin next week, and put up a storm barometer for the use of the fishermen at Herne Bay." And, December 16, 1866, "Thanks be to God, I have preserved a straight course to the best of my abilities, and, though I see others taking short cuts, I think honest dealing and true is the safest ballast to keep the ship in trim, through the sea of difficulties and dangers." Just after his forty-third birthday, he wrote, "I do not aspire to do more than my duty in that station to which it has pleased God to call me, but I want to do it nobly and well."

There was another, a curiosity side to Frank Buckland's character. Nothing was without interest to him; and he was hardly less fond of studying the curiosities of the Barnum Museums than the objects of natural history with which he spent most of his life. He very much enjoyed the bearded woman, of whom he wrote quite extensively, was on good social terms with Captain Bates the giant, and Miss Swan the giantess, and Mademoiselle Millie-Christine, the "two headed nightingale"; knew nearly all the fat women and the other giants, and was fond of making up parties for these people, with the Chinamen, Aztecs, Esquimaux, Zooloos, Siamese twins, tattooed New-Zealanders, and whatever queer specimens of mankind happened to be on exhibition at the time, as fellow-guests.

CORRESPONDENCE.

THE UNIFORMITY OF NATURE AGAIN.

Messrs. Editors:

I READ the first few pages of the Bishop of Carlisle's essay on the "Uniformity of Nature," in the last number of this magazine, with a lively expectation that some of the fog and uncertainty left hanging around the question by the debaters of the "Metaphysical Society" was to be cleared up. But all such expectation ended before I had finished the article. The fog and uncertainty became more bewildering than ever. In fact, it seems to me the worthy bishop missed the mark entirely. He set out to tell us what was meant by the uniformity of Nature, and arrived at the conclusion that, outside of celestial mechanics, it, in effect, meant simply unchangeableness of the weather, uniformity in the direction of the wind, invariableness in the form and density of bodies, etc., and was therefore a principle of only a very limited application.

How absurd, in the first place, to go back to ciphering out by Newton and Laplace of the problems of the laws and motions of the heavenly bodies, for the origin of the practically universal belief in the uniformity of Nature! You might as well go back to them for the origin of our practical belief in density, gravity, inertia, or in the existence of the sun and moon themselves. The whole course of our lives is predicated upon our faith in the uniformity of Nature, upon the belief that fire burns, that cold freezes, that gravity is always operative. Would a man ever plant seed in the ground if he did not believe the laws which govern its growth and development were constant? Have the laws (no matter how ignorant we are of them) which govern steam, which govern all fluids and solids and gases, which govern contraction and expansion and condensation, ever been known to fail? The moment any uncertainty is discovered here, our whole philosophy of mechanics is in ruins. Because the weather is changeable, does the bishop therefore think that the laws which govern the formation of clouds, which determine the course of the winds, and the precipitation of moisture in the shape of rain and snow, are not uniform; that, given the same conditions, the same results will not follow? Would he pray for rain, or for the rain to cease? Would he pray for the postponement of an eclipse? Or would he say that, because man has changed the face of the earth, he has not done it under the rigid operation of natural law? that he has reversed the law of gravity, the laws of heat and cold, of wet and dry, of the tides and the seasons? Is it not true, rather, that he has done it by strictly following and obeying these laws? A belief in the uniformity of Nature does not mean a belief in the uniformity of appearances or of phenomena. The law is not disproved because some of the worlds are large and some small, some hot and some cold, some dense and some thin; or because some animals have two legs and some four or six, some feathers and some hair, or because some crows are white and some swans black, or because some fruit has the seed upon the outside and some on the inside. But show us a country where the trees are walking about, and the men are rooted to the ground, and our belief in the uniformity of Nature will at least receive a severe shock. Would not the same conditions that produce a white crow or a white negro once always produce a white crow or a white negro? This, then, is what we mean and must mean by the uniformity of Nature, that, *given the same conditions, the same results will always follow.* If this truth does not hold good at all times and in all places, then, indeed, is "the pillared firmament based upon rottenness." A breach in the uniformity of Nature means a breach of this law. If ice should fail to melt in the fire, or if water should flow up-hill, or lead swim where a feather would sink, then would the uniformity of Nature be disproved. If the Bishop of Carlisle, or any other person, will make an axe-head swim upon water, as Elisha did, and under the same conditions that would send the iron to the bottom at all other times, then must we either give up the belief in the uniformity of Nature, or else believe in the existence of a set of laws which may be brought to bear upon material bodies by the human will, so as to reverse or annul the laws by which they are ordinarily governed. And the existence of such laws and of such power of the human will is an assumption which no sane man can accept.

If the sun should fail to rise to-morrow, it would be no breach of the uniformity of Nature. If the sun failed to rise, could it be from other than physical or natural cause; from the operation of laws which are uniform in their workings? If we are to believe what astronomers tell us about the disappearance of certain stars, then the sun of some world or worlds has failed to rise on the morrow. Have given the same conditions, and would not our sun disappear also? No; facts of this kind can not be relied upon to invalidate the principle of

the uniformity of Nature. But if the sun stood still for a moment, and no ill-results befell the earth or its inhabitants, that would indeed invalidate the principle.

Pressure and cold will liquefy air, perhaps solidify it, if enough could be brought to bear, but solidified air would not be a miracle, *unless performed without physical means*, like the water and wine miracle in the New Testament; but if the air should fail to support combustion in any given case, under conditions in which it ordinarily supports it, that would be a miracle, and would disprove the uniformity of Nature. It is true that our belief in the uniformity of Nature does not rest upon the same basis as our belief in the principles of mathematics; for instance, that two parallel lines can never meet if indefinitely extended, or that the three angles of a triangle are equal to two right angles, but for my own part my belief in one is just as unshakable as my belief in the other. I do not know, from experience, that no particle of matter can be destroyed, and yet I believe it absolutely. We do not, any of us, know from experience that any calamity would befall the earth if the sun were to stand still for half an hour, yet does anybody doubt it?

I notice that all the divines who have spoken or written upon this subject withhold their belief in the principle of uniformity, in order to save that other cherished belief—the belief in the Biblical miracles. It is incredible what ducking and dodging they will be guilty of, what metaphysical fogs they will conjure up, and what enormous assumptions they will swallow, in order to keep their childish fables from being discredited. The Bishop of Carlisle says the scientific man "can well afford to be generous" and leave the theologians in undisturbed possession of their venerable old scarecrows; but science knows no generosity but the generosity of truth. A miracle is the suspension or annulment of natural law, and there is not the slightest proof, physical or metaphysical, that a natural law ever has been, or ever can be, suspended or annulled except by some other well-known natural law, which thus comes into play and keeps up the continuity of Nature; and the belief or assumption that there has been or can be is the worst kind of infidelity—infidelity toward the works of One in whom there is no variableness or shadow of turning.

JOHN BURROUGHS.

WEST PARK, NEW YORK, *November* 23, 1885.

SCIENTIFIC FREEDOM.

Messrs. Editors:

I NOTICE, in your issue for November last, an editorial comment upon the attitude which Mr. St. George Mivart has assumed, in his recent article in the "Nineteenth Century," on "Modern Catholics and Scientific Freedom." Permit me to correct what seems to me an erroneous inference on your part in regard to this matter, to wit, that Mr. Mivart's opinion is Catholic opinion. So far from this being the case, Catholic opinion holds that Mr. Mivart, in the expression of such views as he puts forth in his late article, is treading upon rash and dangerous ground, and that the *animus* of his paper is without doubt heretical. Catholics can not safely follow him into the extremes to which he goes, nor is it to be supposed that Mr. Mivart's individual opinion is either an authentic or authoritative expression of Catholic views as regards Galileo or evolution, although it must be admitted that the utterances of a gentleman of Mr. Mivart's justly earned scientific and philosophical reputation merit the most respectful attention and careful consideration. While it can not be said that Mr. Mivart's paper contains any formal heresy, its tone is certainly doubtful and inconsistent with the spirit of the Church. He bases it upon a presumed mistake on the part of the Church in the so-called condemnation of Galileo. Mr. Mivart calmly takes this as a matter of course, and does not pretend to advance a single argument in favor of his position—an easy way, indeed, of "brushing aside" the objections of all opponents. In the eyes of Catholics and all impartial witnesses, the Church has never made any such mistake as Mr. Mivart strangely and surely, without due consideration of the facts of the case, imputes to her.

In the first place, a condemnation to be *de fide* must come *ex cathedra* from the Pope himself, and be promulgated in brief or bull *as such*. Secondly, the condemnation of no congregation alone is binding *de fide;* and, thirdly, there was not even such condemnation of the heliocentric system by the Congregation of the Index. Facts are facts, and the slip-shod assumption that a thing is such and such can not pass unchallenged, especially when an argument or theory is based upon a misrepresentation. A congregational condemnation requires a unanimous vote by the members of the Congregation, and in the case of Galileo only seven out of ten cardinals signed the paper condemning his doctrine. Furthermore, the heliocentric system was not a proved fact in Galileo's time, but merely a scientific probability with tremendous weight of scientific authority against it, and, in the then crude condition of physical knowledge, the action of the seven cardinals in condemning the new theory can be readily defended upon grounds of prudence.

In conclusion, I would like to call your attention to a flagrant fallacy in Mr. Mivart's paper—a blunder, indeed, which it seems strange that a man of his logical acumen

should make: In answering a possible objection, namely, that the question in hand is not within the province of the supreme ecclesiastical authority's defining power—"that is, outside the *depositum fidei*"—he says: "What is or is not within the supreme authority's province to decide must be known to that authority. An infallible authority must know the limits of its revealed message. If authority can make a mistake in determining its own limits, it may make a mistake in a matter of faith." Now, the gist of the first half of Mr. Mivart's paper is taken up by the extended assumption that ecclesiastical authority did make a mistake in determining its own limits in the case of Galileo. Therefore it must logically follow, according to Mr. Mivart's proposition, that (supreme?) ecclesiastical authority may make a mistake in a matter of faith. Again he says: "Men of science may have a truer perception of what Scripture must be held (since it is inspired) to teach than may be granted to ecclesiastical authorities"; that "God has taught us (in the instance of Galileo) that it is not to ecclesiastical congregations, but to men of science, that he has committed the elucidation of scientific questions, whether such questions are or are not treated of by Holy Scripture, etc."; that "it must be admitted that men of science so succeeded, and that ecclesiastical authority so failed, in interpreting the true and inspired meaning of God's written word." It is the duty of men of science, therefore, to point out the limits of infallible authority, is Mr. Mivart's assertion. Certainly this is a contradiction to his former proposition, that "an infallible authority must know the limits of its revealed message." Moreover, in the concluding portion of his article, Mr. Mivart coolly tells us up to what limits ecclesiastical authority infallibly extends, and weighs it in the balance against scientific probability with an implied inference in favor of the latter. Mr. Mivart never learned such logic from Catholic sources. He poses in the exact attitude of the objector he so cogently answered in the beginning. Therefore does his own reply rebound upon himself—an infallible authority must certainly determine its own limits.

While respecting Mr. Mivart's attainments to the utmost, Catholics can not do such violence to their faith and their reason as to follow him upon the rash ground whither, no doubt, some hasty and inconsiderate motive has hurried him.

Yours respectfully,

CONDÉ B. PALLEN.

ST. LOUIS, *October* 27, 1885.

THE GENESIS OF A TORNADO.

Messrs. Editors:

AT Orange Heights, in Central Florida, on Sunday, October 11th, a stiff breeze was blowing from the north, as it had blown for some forty-eight hours previously. Masses of clouds, with which the air was laden, were scudding by like ships under full sail. Several times during the day I had noted that an upper current was bearing the higher clouds in an exactly opposite direction. During the afternoon the upper current gradually settled down, until it squarely opposed its adversary, presenting the singular spectacle of two cloud-laden currents of air rushing rapidly together from opposite directions. My point of observation being on an eminence, commanding an extensive view of the surrounding country, I had a fine opportunity to watch the progress of events. For perhaps half an hour these two air-currents flowed swiftly together without apparent result; but presently there appeared in the west, scarcely a mile distant, and just where the two currents came together, a heavy mass of clouds, which constantly increased in density and blackness. The south wind grew constantly more persistent, and although its antagonist showed no signs of weakening, it was gradually crowded out of its course toward the west, and for a quarter of an hour the direction of the two currents was squarely at right angles. Then the great cloud-nucleus, which had so far remained stationary, began slowly to rotate, the east wind passing across the north side, and thence around toward the south; the south wind passing up the east side, and thence around toward the west.

As soon as the rotary motion was established, a progressive motion began. In a few minutes the whole mass had moved out of sight in a northerly direction, and the south wind had full sway. When it was reported next day that buildings and their occupants had been injured by a "cyclone," a few miles to the northward, I was perhaps the only person to whom the news was not unexpected. Fortunately, the aërial monster made its first descent in the pine-woods before attaining great velocity, and was torn and dissipated by the forest before it could rebound.

It seems unfortunate that the terms "tornado" and "cyclone," whose primary meanings afford no clew by which they may be distinguished, are popularly used in exactly the opposite sense from that in which the Signal Service and scientific writers use them.

CHARLES B. PALMER.

ORANGE HEIGHTS, FLORIDA, *October* 18, 1885.

EDITOR'S TABLE.

THE DECLINE OF THE GHOST.

A LONDON correspondent of the "Boston Herald" makes the significant and, from our point of view, encouraging statement that, in all the Christmas annuals—and their name is legion—published this season, there is hardly to be found a single ghost-story. Formerly ghost-stories were of all the most attractive; and somehow they were thought to be particularly suited to Christmas-time. Nowadays the ghost is left out in the cold. In this festive season no one invites him in to so much as "warm his toes," to quote the expression of a prominent Democratic politician. Why is this? What has made the change?

The change is due to several causes. If asked to name the most general of these, we should say *the growing* intelligence of the age. If people don't care to talk or read about ghosts as they once did, it is because they no longer believe or even half believe in them. The world of the living is encroaching more and more upon the world of the dead. In very primitive times men not only believed in ghosts with all their heart and soul, but they attributed to them the same range of activities for good and evil as they attributed to living men. The powers of living men in those days were so limited that it was not paying the ghosts a very inordinate compliment to suppose that they could do as much. But steadily, as the powers of living man increased, as he acquired a more extended control over Nature, the prestige of the ghost, who became more and more conspicuously unable to imitate him, diminished. To-day we leave the ghost out of our reckonings entirely; we neither ask his aid nor strive to avert his malice. When a man is once duly certified as dead, we do not look for any continuance of his personal activity, however great the influence of his character may still be in the world.

The ghost, we fear, has also suffered in popular esteem through being investigated. Modern philosophers have not been afraid of the investigation; they have pushed the ghost hard from age to age, from race to race, from country to country; and their verdict is that, while the ghost-idea has been very potent in the world in past times, and still flourishes in the dark places of the earth, the ghost himself has no estate or effects that it would be worth anybody's while to try to levy upon. The return to the warrant is the disappointing one, *nulla bona*. The ghost, in all his alleged travels through the centuries, has left no monument. There is not one solid piece of work anywhere extant that can be credited to a ghostly origin. If he ever "materialized," he was careful to "dematerialize" again before any one could get a sample of his beautiful work. But, although the ghost himself does not stand out as a *vera causa* of anything, the belief in ghosts has affected in the most important manner the whole course of civilization. This fact the philosophers have brought very prominently forward, and in doing so they have presented for examination such an infinite and grotesque variety of ghost-beliefs, and of usages and ceremonies connected therewith, that the very name of ghost, instead of awakening, as formerly, a host of superstitious terrors, is, to-day, far more suggestive of some methodical and not over-exciting treatise on primitive man. In short, the ghost nowadays is more apt to make us yawn than to make us shudder. What wonder, then, that he no longer rules as of yore in Christmas

literature, and that his general usefulness for purposes of sensation is about at an end?

We shall, perhaps, be confronted with the present wide-spread belief in spiritualism. Is not the ghost active, it will be asked, in spiritualistic circles? Well, spiritualism itself has, in our opinion, been an agency for discrediting the ghost, or, at least, for narrowing and regulating his heretofore willful activities. The spiritualistic ghost, in a word, has been tamed by the medium. He no longer goes gliding or skulking about upon his terrifying nocturnal errands; on the contrary, he comes meekly at the call of his master or mistress, and, the conditions being favorable, utters through the table-leg such harmless platitudes as seem most suited to the average intelligence of the audience. This is a great improvement upon the old plan, according to which every man met his ghost in solitude at the midnight hour, and, with his blood in a state of distressing coagulation, was compelled to listen to some dire prediction of coming doom. All our methods nowadays are more or less scientific, and the comfortable *séance* may be compared to the beneficent lightning-rod, with its many points for draining off the otherwise dangerous electrical accumulations of the atmosphere. Instead of meeting the ghost alone, and encountering the full weight of his supernatural terrors, we meet him in pleasant company, where his force is so dispersed that no one gets more than a proper, moderate, and enjoyable share. At the same time, the ghost that comes and goes at the medium's call, and talks reasonably and mildly through the table-leg, is not, *quâ ghost*, the equal of his more independent and less calculable predecessor. The ghost has declined, there can be no question about it.

Well, as we hinted at the outset, we part with the ghost without reluctance. We think good Christmas-stories can be written without drawing on senseless and half-affected terrors for their interest. We think that literature in general will be the better for shaking itself free from the baseless delusions of by-gone times of ignorance and savagery. The ghost has done nothing in the world that gives him any claim upon our respect or remembrance. He was necessary in his day, in the sense that men had no choice but to believe in him; but, now that we have risen to a point of view that renders him totally unnecessary either for theoretical or for practical purposes, we shall do well to lay him finally to rest. We want to concentrate our energies on this world, to develop all that is best in human life, to methodize our knowledge, to strengthen our hold upon all sound moral principles. For these purposes, close study of facts is required. We need to see things as they are, and to refer them to human welfare, taken in its broadest and highest sense, as a central point. As long as the ghost survived, he could override, and too often did override, our practical judgments; and men never felt sure as to how far they could trust the plain dictates of common sense. But, with the decay and disappearance of the ghost, common sense, purified by the scientific method, assumes full control of human life and reigns without a rival. Henceforth we become free and responsible men—free to follow the dictates of reason, and responsible for doing so. We can now give to the rising generation an integral education founded on reason, and can bring home to their minds as never before the salutary conviction that the reign of law is universal and unbroken—that not even a ghost can violate it—in short, that ghosts and all things of which independence of natural law is predicated are mere figments of the untrained imagination. This, we say, is henceforth possible. It remains to make the possible actual, and to impress upon education once for all that character which no sensible man can doubt it is destined to take in the not distant future.

LITERARY NOTICES.

ECCLESIASTICAL INSTITUTIONS. Being Part VI of the "Principles of Sociology." By HERBERT SPENCER. Pp. 193. Price, $1.25.

THE great life-work of Herbert Spencer, the "Philosophy of Evolution," advances toward completion, but it has moved slowly of late. Persistent ill-health and occupation with other subjects, and other parts of the system than that immediately in hand, have considerably delayed the appearance of the present volume.

Of the general nature of Spencer's "Synthetic Philosophy" little needs here to be said. Our readers are aware that it is a systematic attempt to explain the course of nature, the progress of life, the origin of man, and the institutions of human society, by one universal law of unfolding known as evolution. While in one aspect this system is simply a new organization of knowledge based upon the progress of science, and more comprehensive and unified than anything previously attained, in another aspect it is a new body of doctrine which discredits and replaces the most wide-spread and deeply cherished traditional beliefs of mankind. In the volume now before us Mr. Spencer has reached that stage in the development of his system in which he comes into the sharpest collision with all-prevalent religious dogma.

No discussion of the evolution of human society is possible which does not make the study of primitive social conditions and ideas prominent and fundamental. If the higher social forms were potentially involved in the lower, and had grown out of them by the working of natural laws, then the first and most important step of the investigation must be into the nature, capacities, and limitations of the primitive man, and the character of the primitive elements of society which grew out of, and were determined by, the attributes of the primitive man. Accordingly, the first part of the first volume of the "Principles of Sociology"—"The Data of Sociology"—is devoted to primitive man and that order of primary conceptions which was embodied in the earliest and rudest social institutions. These institutions are now so highly developed that we have got in a way of separating ourselves from "the heathen" by a great gulf, which makes all continuity of relations between the lowest and the highest impossible. But, if evolution be true, the highest is derived from the lowest by unbroken chains of causation, and there is no other possible way of explaining and understanding existing institutions than by tracing their derivation back to primitive germinal conditions. This is, at any rate, the only way open to science which is an exposition of the natural order; and sociology only becomes a true science as it is pursued by the method adopted by Mr. Spencer of working out the laws under which social progress has taken place. The data of sociology in the primitive conditions which initiated the lowest social state constitute, therefore, the essential basis of the science, and determine the whole course of subsequent elucidation.

In Part II Mr. Spencer works out "The Inductions of Sociology," or the nature, structure, and functions of the organism of society; and in Part III, "The Domestic Relations," he treats of the maintenance of species, the relations of the sexes in primitive society, and the development of the family.

Volume II of the "Principles of Sociology" begins with Part IV, on "Ceremonial Institutions," the evolution of which is traced from early to advanced societies. Part V takes up "Political Institutions," and these with their development by the same method. "Ecclesiastical Institutions" (Part VI), now published, as the title imports, treats of the evolution of existing religious organizations from their lower forms in primitive society. Its necessary implication, of course, is, that the religious, like all other social institutions, have a natural genesis, and can only be explained as derivations from pre-existing forms which carry us backward and downward to the religious notions, rites, and observances of the earliest men. The nature of the religious idea is first unfolded, and it is shown how religious ceremonies were at first mixed with others, so that medicine-man, ruler, and priest, were combined in the same individual. The rise of a separate priesthood and of religious hierarchies is then traced out, and the argument is pursued till we reach the modern forms of ecclesiastical institutions, "Church and State," "Nonconformity," and "The Moral Influences of Priesthoods." Two

other parts remain to be written for the completion of the second volume of "The Principles of Sociology," viz., "Professional Institutions" and "Industrial Institutions"; but there is reason to expect that these will be completed with less delay than has occurred with Part VI. We find a notice of the present volume in the "Pall Mall Gazette," which is so excellent that we make an extract from it:

"Ecclesiastical Institutions" begins with a short restatement and re-enforcement of the ghost-theory of the origin of religion already laid down in the first volume of the Sociology. It is interesting to note how much new confirmatory evidence has been rapidly accumulated during the intervening period; and Mr. Spencer therefore wisely chooses most of the fresh instances by which he strengthens his case from works published since the appearance of his earlier volume. In one of these in particular, the Rev. Duff Macdonald's "Africana," conclusions almost identical with Mr. Spencer's own have actually been arrived at by a Scotch missionary in the heart of Africa, in apparent total ignorance and independence, and without a passing glimpse of their ulterior implications. From the origin of the religious idea itself, here assigned to the belief in a soul, and consequent ancestor-worship, Mr. Spencer gradually passes on to the evolution of ecclesiastical or hierarchical systems. Beginning with the medicine-man, as the propitiator or averter of hostile ghosts, and the priest properly so called, as the propitiator and attendant of friendly ghosts—the family gods or manes—he proceeds to trace the gradual development of the organization which results with increasing culture from the last of these two classes of functionary. Descendants, he shows, are the first priests; and more especially male descendants, at least wherever the position of women has become one of marked inferiority. But the eldest male descendant in particular—in short, the head of the family—tends to concentrate upon himself the highest duty of the priesthood. Moreover, as the chief gods in early communities are deceased rulers, the king, as their living representative, exercises the functions of priest also. In process of time, the king frequently finds the priestly offices clash with other duties, and then he delegates them to others: they are performed by proxy. Hence in most instances the origin of a distinct non-royal priesthood. The rise of such priesthoods is well shown in the case of the Flamens, instituted at Rome to replace the king during his temporary absence. As the ghost gradually develops into the god, polytheistic priesthoods of the advanced type are evolved side by side with the evolving religion. Sometimes the Pantheon has its relative ranks assigned by conquest and incorporation; the gods of the vanquished tribes take their place amicably in the same system with the gods of the victors, but naturally enough on a lower level. Eventually the slow elevation of one great god to a position of marked superiority in the Pantheon may give rise to a gravitation toward monotheism. Thus, to the philosophic Greeks of the age of Socrates, Zeus had almost arrived at that point of supremacy over other gods which lifts the "father of gods and men" into the true monotheistic position, the other deities at the same time sinking to the subordinate grades in a sort of angelic hierarchy. Mr. Spencer next goes on to notice the value of the ecclesiastical system as a social bond, especially in early times, the military and civil functions of priests, and the question of the relations between Church and State. A very Spencerian chapter on Nonconformity is replete with its author's ingrained independence and individuality of character; for Mr. Spencer is nothing if not individualist in fiber. The book ends with an ecclesiastical and then a religious retrospect and prospect where timid waverers may find much to console and to reassure them. Mr. Spencer does not see in the threatened changes of form any final menace even to religious worship in its proper essence. He anticipates that there will always remain a necessity for qualifying the too prosaic and material form of daily life by religious observances; that a sphere will still exist for those who are able to impress their hearers with a due sense of the mystery which enshrouds the universe; and that musical expression to the sentiment accompanying this sense will not only survive but will undergo further development. Finally he concludes with the reiteration of the idea already so fully insisted upon in the "First Principles": "One truth must ever grow clearer—the truth that there is an inscrutable existence everywhere manifested, to which [man] can neither find nor conceive either beginning or end. Amid the mysteries which become the more mysterious the more they are thought about, there will remain the one absolute certainty, that he is ever in presence of an Infinite and Eternal Energy from which all things proceed.'

INTERNATIONAL SCIENTIFIC SERIES, NO. LI.

PHYSICAL EXPRESSION: Its Modes and Principles. By FRANCIS WARNER, M. D., Lond., F. R. C. P. New York: D. Appleton & Co. Pp. 372. Price, $1.75.

THIS is an old subject much discussed by artists, anatomists, alienists, and physiognomists, from Leonardo da Vinci onward. It has a copious literature, and, in the long list of works given by Dr. Warner in his bibliography, those of Sir Charles Bell, on the "Anatomy and Physiology of Expression," and of Charles Darwin, on the "Expression of Emotion in Man and the Lower Animals," are prominent. But so interesting a subject as that of the physiological signs of inward states could not fail to attract multitudes of observers who have contributed to it in many aspects. Fancy and speculation, however, have outstripped science with its explanations of the double mechanism involved. There has been great recent advance in our knowledge of the

structure and functions of the nervous system, and in the development of psychology, from the physiological side; while results from both are of great value in arriving at the principles involved in expression. Dr. Warner takes up the subject broadly and aims to treat it in the light of all that has been gained in the various lines of research that bear upon it. Premising that the work is written with clearness and judgment, and is fully illustrated, the reader will gain the best idea of its contents by a statement of the topics considered. The first five chapters are devoted to an analysis of the nature and the modes of expression. Chapter VI treats of its physiology; Chapter VII of its pathology; Chapter VIII of postures; Chapter IX of expression in the hand; Chapter X, expression in the head; Chapter XI, expression in the human face; Chapter XII, expression in the eyes; Chapter XIV, the infant and adult; Chapter XVII, art criticism; and Chapter XIX, new apparatus for observing and recording expression.

RECENT AMERICAN SOCIALISM. By RICHARD T. ELY. Baltimore: N. Murray. Pp. 74.

THE author passes the history of the early socialistic movements in the United States with a rapid sketch-review, and gives his attention principally to the consideration of socialism as it has manifested itself since the publication of Mr. George's "Progress and Poverty." His object is to present the character of the movements, not to pass judgment on them; and it is no compliment to the intelligence of average readers that he has felt it incumbent to excuse himself for not obtruding his own views of their merits and demerits; as if, in recording that some of the organizations advocated dynamiting, he should think it necessary to say explicitly that he thought that very bad. In his presentation, the author has endeavored to let the parties concerned speak for themselves as far as possible, thereby securing further accuracy and impartiality. He classifies the advanced Socialists of the present day into the two groups of the Internationalists—a party of violence, believing in the use of dynamite and like weapons of warfare as a means of attaining their purpose—and the Socialistic Labor party, who condemn these tactics, and some of whom have not renounced all hope of a peaceable revolution of society; and calls attention to the superior character of the men of the latter party as compared with those of the former. Besides these are the labor unions, not actually and avowedly socialistic, but liable to tendencies in that direction and claimed as at least prospective allies by the socialists. The danger from these movements is real, though the extreme peril may not be immediate; and "of course we all hope for the best, but in the mean time it may be safer to fear what is worse, and it can do no harm to be watchful." As for a remedy, "there is no simple, easily applied formula which will cure social evils, and any one is a quack who pretends to have found one. Repressive legislation, in the absence of overt acts, has failed to repress the growth of the socialistic sentiment, and is likely to fail. The cure is to be sought in the opposite direction, of finding out what are the real, reasonable grievances of the men among whom this sentiment is cultivated, and devising and applying measures to ameliorate them. Then, with this purpose kept honestly in view, "in the harmonious action of state, church, and individual, moving in the light of true science, will be found an escape from present and future social dangers. Herein is pointed out the path of safe progress; other there is none."

PLANTING TREES IN SCHOOL-GROUNDS, AND THE CELEBRATION OF ARBOR-DAY. Washington: Government Printing-Office. Pp. 64.

THIS is a document issued by the Bureau of Education for the purpose of cultivating interest in the planting of trees and of turning attention in the direction in which the work may be most profitably done. It contains "lessons from history" and other facts, to show the importance of preserving the forests; selections from literature and poetry, to be used in making up the programme for the exercises of Arbor-day; and a practical essay on "Planting Trees in School-Grounds." In this paper we observe the suggestion that, in selecting the kinds of trees to be planted in school-grounds, regard should be had to their liability to injury from accident, their tendency to sprout where not wanted, the agreeable or disagreeable odors that they may emit, the ornamental

character of their flowers or fruit, their longevity, rate of growth, and other circumstances tending to make them more or less acceptable in the places where they are to remain. The American elm and the soft maples appear to be among the trees best adapted to this purpose.

OFFICES OF ELECTRICITY IN THE EARTH, pp. 42; and ORIGIN OF SPECIES, pp. 76. By H. B. PHILBROOK. New York: "Problems of Nature," 21 Park Row.

THESE two pamphlets, which together attempt a new cosmology and a theory of development intended to take the place of the "mistaken attempt" of Darwin, furnish an example of the nonsense which a class of visionary theorists imagine they can pass off for science. The basis of Mr. Philbrook's system is that the universe and all its parts and contents are manifestations of electricity. When he comes to details, he is startling as well as amusing. Thus: "The atmosphere is only a continuation of the condensation of the electricity of the solar system, and each atom of gas of this abundant element is but a slightly condensed globe of mica." Gold "is produced simply by a great pressure of particles of mica. Silver is constructed by the pressure of chalk; copper by the pressing of the mica partly decomposed, and the substance is but little different from gold. Iron is produced by pressing quartz and the undecomposed mica in it." Coal is formed by the exposure of coral to great heat, and exists wherever there are mountains: in the Orange Mountains of New Jersey, and in Massachusetts, "sufficient coal for a whole nation," and if bored for deep enough, will be found there. Less heat than is required to convert coral into coal produces trap.

NIAGARA PARK ILLUSTRATED. Edited by ALICE HYNEMAN RHINE. New York: Niagara Publishing Company. Pp. 112. Price, 50 cents.

THE author gives as a reason for having prepared this book, "a desire to commemorate the freedom of Niagara from individual possession, and becoming in a manner the property of the world. Surely, if anything deserves a printed formal recognition, it is the removal of that great indignity done to Nature's masterpiece in the past." Her thought was a happy one, and her execution is worthy of it—and as nearly worthy as a modest human effort can presume to be, of the subject. A better guide the visitor need not ask for, and a more agreeable companion in a guide he is not likely to get. The directory of points of interest on the American and Canadian sides forms a but relatively small part of the book, but it is the practical part, and is ample for its purpose. The mass of the book is made up of choice articles from travelers and poets, most of them classics in English and American literature, describing the falls or reflecting the emotions which they have awakened; in short, it is a compendium of that which is best in the literature and romance of the falls. These articles are accompanied by numerous excellent illustrations.

HISTORY AND MANAGEMENT OF LAND GRANTS FOR EDUCATION IN THE NORTHWEST TERRITORY. By GEORGE W. KNIGHT. New York: G. P. Putman's Sons. Pp. 175. Price, 50 cents.

THIS work is number three in the series of papers of the American Historical Association. It reviews the history of all the grants of land that have been made by Congress in aid of education in the Northwest Territory and the States of Ohio, Indiana, Illinois, Michigan, and Wisconsin; the dispositions that were made of them in the several States; the manner in which the funds accruing from them have been managed; and the net results in benefit to education that have been derived from them. The grants were variously made to the Territory as a whole, and to the States in severalty; they included the "school-section" in every township of thirty-six sections; saline lands, swamp-lands, grants for seminaries or universities, grants for agricultural colleges, and special grants. The grants have in no case been as well managed as they might have been, and have been in some instances badly managed, with much waste; but, with all this, they have been "instrumental, in a degree that can not be estimated in mere dollars and cents, in promoting the cause of education. It is doubtful if with the wisest management the school-land could have been made to maintain unassisted the work for which it was set aside. Perhaps the greatest benefit ren-

dered by the funds has been in fostering among the people a desire for good schools. Without the land grants, the burden of maintaining free schools would have seemed oppressive to the new State, but, aided by the income of the funds, the people have grown into a habit of taxing themselves heavily for the support of education. Thus the funds have made practicable a system of education which without them it would have been impossible to establish."

CITY SCHOOL SYSTEMS IN THE UNITED STATES. By JOHN D. PHILBRICK. Washington, D. C.: Government Printing-Office. Pp. 207.

THIS work is No. 1 of the "Circulars of Information" of the Bureau of Education for 1885. Its author is one of the most experienced of American city school superintendents, and one who has written or said a great deal on educational subjects; and in it he has presented an extensive review of the principles and conditions of the educational organizations, generally, of all the towns in our country having populations of more than eight thousand or thereabout, and particularly of the larger cities which have the most clearly defined systems. The points to which attention is chiefly directed cover the administration and organization of the schools; the classes and kinds of schools; the studies, supervision, programmes, and supplementary reading provided for; industrial education; physical and other drill; gratuitous instruction; gratuitous text-books the tenure of office of teachers; the sex of teachers; examinations, promotions, and exhibitions; the question of "recess and no recess," concerning which he speaks with force against the abolition of recess; school ages; sufficiency of accommodation; schoolhouses, museums, decorations and art; pedagogical libraries; and coercive attendance.

THE BOYS' AND GIRLS' PLINY. Edited, with an Introduction, by JOHN S. WHITE, LL. D. New York: G. P. Putnam's Sons. Pp. 326, with Illustrations. Price, $3.

IN this adaptation, which is the third and last of a brief series of classical authors — Plutarch, Herodotus, and Pliny — which the editor has prepared for the reading of boys and girls, the selection is made from the most interesting parts of Pliny's "Natural History." As the author's science, however pleasant reading it may be—and in that respect it is not excelled—would not be good science in the present day, it calls for frequent correction; this is given in all cases where Pliny's statements have been proved erroneous, except where they are so evidently preposterous as to need no comment. For his foot-notes, the editor has had recourse to Cuvier, Bostock, and Ajasson, devoted students of Pliny, he says, "whose work can rarely be improved upon." In the introduction are given the life of Pliny and his nephew's account of his death by the eruption of Vesuvius.

TWENTY-FIVE YEARS WITH THE INSANE. By DANIEL PUTNAM. Detroit: John Macfarlane. Pp. 157. Price, 75 cents.

THE author of this book was for twenty-five years Chaplain of the Michigan Asylum for the Insane, at Kalamazoo, and he sets forth here the results of his experience and observations in that capacity. After an historical review of the development of the modern methods of taking care of the insane, he considers their proper care in asylums, their treatment outside of asylums, depicts the opinions and feelings of patients, and discusses the relations of schools, religion, alcohol, tobacco, and other narcotics, inherited tendencies, and crime, with insanity. He believes that asylums and hospitals for the insane have done much for the relief of one of the most pitiable forms of human suffering, and that it is possible for them to do more and better in the future.

THE CO-OPERATIVE COMMONWEALTH IN ITS OUTLINES. By LAWRENCE GRONLUND. Boston: Lee & Shepard. New York: Charles T. Dillingham. Pp. 278. Price, $1.

THIS book presents to the reader, in a concise, logical, and readable form, the principal propositions of modern socialism, from the point of view of a socialist. It has been written, according to the professions of the author, that it may be seen that the social and political phenomena in all progressive countries, and particularly in our own country and Great Britain, are, in a perfectly natural manner, evolving a new social order, a social-democratic order, to which the name of the "Co-operative Commonwealth" is

given, or, that socialism is no importation, but a home product, wherever found; to give good reasons for expecting that the new social order will be a "happy issue" to every one, and to justify the conviction that the situation must come to this new order within a comparatively short period, or to barbarism. The author has also a more serious purpose than the one of mere information, which is to prepare the public to take such an attitude as to make the revolution, which he foresees as a certainty, a bloodless and dangerless one, resulting in the establishment of a wholesome security.

THE BLOOD-COVENANT. By H. CLAY TRUMBULL, D. D. New York: Charles Scribner's Sons. Pp. 350. Price, $2.

THE blood-covenant is a rite by which two persons absorb each the other's blood, either by drinking or by transfusion to the veins, whereby they become bound to one another in even a closer connection than that of brotherhood. It prevails in many countries—savage, barbarous, and semi-barbarous—and may be traced back to extreme antiquity. Dr. Trumbull discovers it first in Syria; then finds numerous accounts of it in the journals of African travelers and of adventurers among the North American Indians; detects it in the Norse lands of Europe and in India, and so around the world. He might also have found it a characteristic custom among the Albanians and some of the south Slavs. Going back into history he finds it still more prevalent in the olden times, and, seeking to discover it in its origins, he detects it in the rites and literature of the ancient Egyptians, and allusions upon allusions to it in the books of the Bible. Besides description and history, the purpose of his book is to investigate the meaning and symbolism of the rite. He believes that its origin, to use one of the many statements he makes respecting it, is in "the universally dominating primitive convictions that the blood is the life; that the heart, as the blood-fountain, is the very soul of every personality; that blood-transfer is soul-transfer; that blood-sharing, human or divine-human, secures an inter-union of natures; and that a union of the human nature with the divine is the highest ultimate attainment reached out after by the most primitive as well as by the most enlightened mind of humanity." With savage and barbarous peoples the rite lies at the foundation of cannibalism; it is the motive of sacrifices, in which the animal is offered to the god as a substitute for the human blood. In one form the drops of blood were put in wine or other draughts and drunken: then the wine was drunken without the actual presence of the blood; whence we have the use of wine in pledges of friendship and in marriage. Among the Jews it is symbolized in circumcision; and, finally, it found its culmination in the offering of the blood of Christ, which Christians of all denominations again observe symbolically, after their Master's own institution, in the use of wine at the sacrament. These views, which Dr. Trumbull sets forth with much force and copious illustrations by references and quotations, are not a theory which he set out to prove, but are thoughts that have grown upon him as he has advanced in his work, and have been suggested by his researches; and the fact that they have been hitherto overlooked furnishes, to his mind, another illustration of the "inevitably cramping influence of a preconceived fixed theory—to which all the ascertained facts must be conformed—in any attempt at thorough and impartial scientific investigation."

MIND-CURE ON A MATERIAL BASIS. By SARAH ELIZABETH TITCOMB. Boston: Cupples, Upham & Co. New York: Brentano Brothers. Pp. 288.

THE author of this work having acquired the method of curing disease which is practiced by the mind-curers, came to the conclusion that the success attending that method is due to concentration of thought, and not to the theology underlying the method. She regards it as a well-attested fact that disease, even inorganic, can be cured as well as caused by the mind or the imagination. Besides especially elaborating this theory she reviews "The Theology of the Christian Scientists"; discusses "The Single-Substance Theory," or Materialism, and the manifestations of "Mind in Animals and in the Lower Races of Men"; attempts to trace "The Origin of the Doctrine of the Immortal Soul"; and searches for "Bible Proofs of the Single-Substance Theory."

METHODS OF RESEARCH IN MICROSCOPICAL ANATOMY AND EMBRYOLOGY. By CHARLES OTIS WHITMAN. Boston: S. E. Cassino & Co. Pp. 255. Price, $3.

THE aim of this work is to supply in a measure a need which has been created by the rapid development of the methods of microscopical anatomy and embryology within the last few years. The contents of the volume have been arranged in two parts, the first embracing methods of a more general nature, such as preservative fluids, dyes, macerating fluids, fixatives, mounting media, the microtome with its appurtenances, methods of imbedding, etc.; and the second including special applications of embryological, anatomical, and histological methods. Under the head of "embryological methods" are given, besides accounts of objects of study, notes on such points as the times, places, and best methods of collecting, breeding-habits, food, and other items of information that may aid the student in making a choice of material and controlling its supply. The part on special methods is designed to meet the wants of the beginner as well as of the more advanced student.

REPORT ON FORESTRY (Department of Agriculture). Prepared by NATHANIEL H. EGLESTON. Vol. IV. 1884. Washington: Government Printing-Office. Pp. 421.

THIS report is compiled from the replies to the circulars of inquiry which have been sent out to various parts of the country, asking for information respecting different points in the condition of the forests and the consumption of wood. The facts thus gathered are arranged in the shape of special reports by agents of the department, as on the collection, preservation, and planting of seeds or young trees in the prairie States; the condition of forests, timber-culture, etc., in the Southern and Western States; on the kinds and quantity of timber used for railroad-ties (from facts furnished by two hundred and eighty-three railroad companies); on the decrease of woodlands in Ohio; on the forest condition and lumber and wood trade of certain States; on the growth, etc., of trees; on the forests of Washington Territory; and on the production of maple-sugar in the United States and Canada.

THE GERMAN VERB-DRILL. By ADOLPHE DREYSPRING. New York: D. Appleton & Co. Pp. 276.

PROFESSOR DREYSPRING is the author of the "Cumulative Method" of teaching German, which he illustrates by the motto—*Repetitio mater studiorum*—"repetition the mother of studies." The purpose of this work is to present the mechanism of the colloquial and written languages in a series of exercises on the verbs, always lively and varied, yet subject to a well-ordered system. The author selects this part of speech as the central object of the exercises, because he believes that the office of none other is more complex, more important, and more useful in ministering to the power and intelligibility of expression. It is also the part of speech which in German as in other languages goes through more inflections and raises more difficulties in construction than any other; so that whoever masters the verb has little difficulty with anything else. The verb-drill takes the form of a lively conversation between the teacher and the class, in which a single verb being selected for the day's lesson, it is passed along in its inflections and with its combinations. The plan appears to us, looking at it from without, adapted to facilitate the study of language and make it more interesting, while it is also fundamental and thorough.

LECTURES ON THE PRINCIPLES OF HOUSE-DRAINAGE. By J. PICKERING PUTNAM, Architect. Boston: Ticknor & Co. Pp. 125. A GUIDE TO SANITARY HOUSE-INSPECTION. By WILLIAM PAUL GERHARD, C. E. New York: John Wiley & Sons. Pp. 145. Price, $1.25.

THE "Lectures" of the former volume were delivered at the Massachusetts Institute of Technology, before the Suffolk District Medical Society and the Boston Society of Architects. Their scope is chiefly the presentation of the principles on which the drainage appliances of houses should be constructed and arranged, with criticisms of existing appliances and arrangements. The author has himself devised some new appliances, the qualities of which he describes, but always with an honest notice to the reader that he is talking about his own work. A foreign and independent judgment of the

value of the lectures is given in a request which was made by the editor of the "Sanitary Record," London, for permission to republish them.

The principal aim of Mr. Gerhard's book is to instruct the householder respecting the main features of a sanitary house-inspection, particularly in the matter of searching for defects in the arrangements. First is considered the inspection of city houses as to their surroundings and soil, the cellar, yard, structural details, sewerage and plumbing, water-supply, method of garbage disposal, arrangements for warming, gas-lighting, ventilation, for exclusion of bad odors, prevention of dust, and for safety against fire; next, are articles on apartment-houses and tenement-houses, on country-houses, which, like city-houses, are treated in detail, and on summer boarding-houses and summer resorts.

MARVELS OF ANIMAL LIFE. By CHARLES FREDERICK HOLDER. New York: Charles Scribner's Sons. Pp. 240, with Plates. Price, $2.

THE aim of this inviting volume is to interest youth in natural history by pointing out the attractive side and so presenting its interesting features that they will go out and become investigators for themselves. It relates wholly to marine life. Many of the observations chronicled in it, the author says, "were made during a long residence upon a coral reef or atoll, some while swimming under water along the bristling coral banks that formed a characteristic feature of our tropical home, and others are the memories of many practical collecting tours in various localities." The author displays much talent in presenting the brighter sides of his pictures.

RUDDER GRANGE. By FRANK R. STOCKTON. Pp. 322. Price, $1.25. THE LAST MEETING. By BRANDER MATTHEWS. Pp. 268. New York: Charles Scribner's Sons.

"RUDDER GRANGE" is an amusing sketch of experiments in housekeeping, rather fanciful than real, we judge, which we have read with much pleasure, and can commend as all healthy and good for a leisure moment. "The Last Meeting" has a more elaborate plot and greater variety of incident, and appears to deal with sadder scenes.

THE COMMONWEALTH OF GEORGIA: THE COUNTRY, THE PEOPLE, AND THE PRODUCTIONS. Prepared under the direction of J. T. HENDERSON, Commissioner of Agriculture. Atlanta: J. P. Harrison & Co. Pp. 379. With Fifteen Maps. Price, $1.

IN this work, which is published under the authority of the State, as a hand-book, the attempt is made to depict, by a series of maps, in an intelligible and acceptable way, the geology, agriculture, temperature and rainfall, water-powers, forestry, minerals, and elevations of Georgia. In the letterpress are given, with considerable detail, descriptions of the population, public institutions, government, educational establishments, newspapers, and of the fruit, grass, garden, and field products.

PUBLICATIONS RECEIVED.

Natural Gas: Its Advantages, Use, and Economies. By George H. Thurston. 1885. Pittsburg: A. A. Anderson & Son, Printers. Pp. 32.

Fifth Report of the Shell-fish Commissioners of the State of Connecticut to the General Assembly, January, 1886. 1885. Middletown: Pelton & King, Printers. Pp. 26.

Report of the Proceedings of the Illinois State Board of Health. Quarterly Meeting, Springfield, October 29, 30, 1885.

Geometrical Form of Volcanic Cones and the Elastic Limit of Lava. By George F. Becker. Reprint from the "American Journal of Science." Pp. 11.

A Contribution to the Vertebrate Paleontology of Brazil, and Second Continuation of Researches among the Batrachia of the Coal-Measures of Ohio. By E. D. Cope. 1885. Philadelphia: A. E. Foote.

On Polysynthesis and Incorporation as Characteristics of American Languages. By Daniel G. Brinton, M. D. 1885. Philadelphia: McCalla & Stavely. Pp. 41.

The Physiological and Pathological Effects of the Use of Tobacco. By Hobart Amory Hare, M. D. 1885. Philadelphia: P. Blakiston, Son & Co. Pp. 86. Illustrated.

Index to the Literature of Uranium, 1789–1885. By H. Carrington Bolton, Ph. D. 1885. Washington: Government Printing-Office. Pp. 36.

Remarks on a Supposed Fossil Fungus from the Coal-Measures. By Professor Joseph F. James. Pp. 10.

Saratoga Winter and Summer: An Epitome of the Early History, Romance, Legends, and Characteristics of the Greatest of American Resorts. By Prentiss Ingraham. New York, 1885. Pp. 110. Illustrated.

Forest Preservation in Canada. By A. T. Drummond. Montreal, 1885. Pp. 7.

Introspective Insanity. By Allan McLane Hamilton, M. D. Reprint from the "American Journal of the Medical Sciences." 1885. Pp. 8.

Free Cities in the Middle Ages. By L. R. Klemm, Ph. D. Hamilton, Ohio. Pp. 22.

Inaugural Exercises of the Henry Shaw School of Botany. Washington University, St. Louis, Mo. 1885. Pp. 24.

Report of the Committee on Indexing Chemical Literature. By H. Carrington Bolton. Pp. 5.

Cervalces Americanus. A Fossil Moose or Elk

from the Quaternary of New Jersey. By W. B. Scott. Pp. 22. Illustrated.

Chemistry in the Service of Public Health. By William Ripley Nichols. 1885. Salem Press: Salem, Mass. Pp. 20.

The Fixed Idea of Astronomical Theory. By August Tischner. 1885. Leipsic: Gustav Fock. Pp. 86.

Forty-second Annual Report of the New York Association for improving the Condition of the Poor for the Year 1885. New York, 1885.

The Necessity for Closer Relations between the Army and the People, and the Best Method to accomplish the Result. By Captain George F. Brice, U. S. A. 1885. New York: G. P. Putnam's Sons. Pp. 30. 25 cents.

Price List of Publications of the Smithsonian Institution. July, 1885. No. 627. Washington: Government Printing-Office. Pp. 27.

Third Annual Report of the Board of Control of the New York Agricultural Experiment Station for the Year 1884. Albany: Weed, Parsons & Co. 1885.

Why Modern Cremation should replace Earth-Burial. 1885. San Francisco: Bacon & Co.

Astronomical Papers prepared for the Use of the American Ephemeris and Nautical Almanac. Vol. II, Parts III and IV; Velocity of Light in Air, and Refracting Media. 1885. Washington: Government Printing-Office.

The Physician's Visiting List for 1886. Philadelphia: P. Blakiston, Son & Co. Various sizes, at prices from $1 to $3.

Ventilation of Buildings. By W. F. Butler. Re-edited and enlarged by James L. Greenleaf, C. E. New York: D. Van Nostrand. Pp. 147. Price, 50 cents.

Chemical Analysis for Schools and Science Classes. By A. H. Scott White. New York: Scribner & Welford. Pp. 130.

The Idea of God as affected by Modern Knowledge. By John Fiske. Boston and New York: Houghton, Mifflin & Co. Pp. 173. Price, $1.

First Lessons in Philosophy. By M. S. Handley. New York: Scribner & Welford. Pp. 59.

Bird-Ways. By Olive Thorne Miller. Boston and New York: Houghton, Mifflin & Co. Pp. 227. Price, $1.

Men, Women, and Gods, and other Lectures. By Helen H. Gardener. New York: The "Truth-Seeker" Company. Pp. 158. Price, $1.

Railroad Transportation: Its History and its Laws. By Arthur T. Hadley. New York: G. P. Putnam's Sons. Pp. 269. Price, $1.50.

Afternoon Songs. By Julia C. R. Dorr. New York: Charles Scribner's Sons. Pp. 184. Price, $1.50.

Chemical Equilibrium the Result of the Dissipation of Energy. By G. D. Liveing. New York: Scribner & Welford. Pp. 97, with Plates.

Darwinism and other Essays. By John Fiske. New edition, revised and enlarged. 1885. Boston and New York: Houghton, Mifflin & Co. Price, $2.

Charles Darwin. By Grant Allen. 1885. New York: D. Appleton & Co. Pp. 206. 75 cents.

Physical Expression: Its Modes and Principles. By Francis Warner, M. D., Lond., F. R. C. P. 1885. New York: D. Appleton & Co. Pp. 372. Price, $1.75.

A Political Crime. By A. M. Gibson. New York: William S. Gottsberger. Pp. 402.

Elements of Universal History. By Prof. H. M. Cottinger. Boston: Charles H. Whiting. Pp. 836.

Social Wealth. By J. K. Ingalls. New York: The "Truth-Seeker" Company. Pp 320. Price, $1.

The Pedigree of Disease. By Jonathan Hutchinson, F. R. S. New York: William Wood & Co. Pp. 118.

Gray's Botanical Text-Book. Vol. II. Physiological Botany. By George Lincoln Goodale. New York: Ivison, Blakeman, Taylor & Co. Pp. 584.

Poems. By Jamin Willsbro. Philadelphia: Benjamin F. Lacey. Pp. 119.

Italian Popular Tales. By Thomas Frederick Crane. Boston and New York: Houghton, Mifflin & Co. Pp. 389. Price, $2.50.

The Silent South. By George W. Cable. New York: Charles Scribner's Sons. Pp. 180. Price, $1.

A Mortal Antipathy. By Oliver Wendell Holmes. Boston and New York: Houghton, Mifflin & Co. Pp. 307. Price, $1.50.

Report of the Chief Signal Officer of the Army for 1884. Washington: Government Printing-Office. Pp. 719, with Charts.

Manual of the Botany of the Rocky Mountain Region. By John M. Coulter, Ph. D. New York: Ivison, Blakeman, Taylor & Co. Pp. 480.

Psychiatry. By Theodore Meynert, M. D. Translated by B. Sachs, M. D. New York: G. P. Putnam's Sons. Pp. 285. Price, $2.75.

The Prehistoric Palace of the Kings of Tiryns. By Dr. Henry Schliemann. New York: Charles Scribner's Sons. Pp. 385, with Chromo-Lithographic Plates, Map, and Plans. Price, $10.

POPULAR MISCELLANY.

Prehistoric Human Remains in Mexico.—Mariano de la Barcena describes in the "American Naturalist" some human remains that have been found in the hill Peñon de los Baños, near the city of Mexico, imbedded in a hard rock of silicified calcareous tufa. The cranium, with the upper and lower maxillæ and fragments of the collar-bone, vertebræ, ribs, and bones from the upper and lower limbs, are exposed, and present a yellowish appearance and the characteristic aspects of fossilization. No other fossils occur in the hill, and the age of the formation can only be estimated. The bed has evidently suffered upheaval since the bones were deposited in it, and their disordered condition is accounted for by this fact. Two facts seem at once to show that, even supposing it to be of the present age, it must be of remote antiquity. They are, the elevation of the ground above the actual level of Lake Texcuco, and the remarkable hardness of the rock, which is different from that of the other calcareous rocks that contain remains of ceramics or roots of plants clearly modern. The stratigraphical and lithological characteristics of the ground indicate that the formation belongs to the Upper Quaternary, or at least to the base of the present geological age.

Forests of the Pacific Region.—According to our census report, the forests of the Pacific region owe their density and position to the character of the rainfall, which is heavier on the northern part of that coast than anywhere else in the United States; and their general distribution and density follow the distribution and amount of the rainfall, diminishing as we go southward into drier climates. The forests of this region are: the Northern forest, from the seventieth to the fifty-eighth degree of latitude, composed principally of white spruce and species allied to but not identical with the canoe-birch and balsam-fir of the Atlantic coast; the Coast forest, extending in a narrow strip from the sixtieth to the fiftieth parallel, and thence along the summit of the Sierra Nevada, almost to the Mexican line, composed of a few coniferous species, among which are the Alaska cedar, the tide-land-spruce, the hemlock, and the red fir. Its important feature is the red-wood belt, whose heaviest growth is found north of the Bay of San Francisco, and which contains more wood than any other forest of similar extent. The forest of the western slope of the Sierra Nevada, extending from the base of Mount Shasta to the thirty-fifth parallel, is next in density, is from four thousand to eight thousand feet above the sea, and is characterized by the great sugar-pine. The forest of the Valleys is composed of scattered oaks; and the Interior forest, from the Sierra to the Rocky Mountains, is of inferior importance.

How Milk is tainted.—According to the "Live-Stock Journal," milk is most liable to be hurt by the absorption of odors when it is colder than the surrounding air. For when it is warmer, the air, warmed by the contact with it, expands, with an increased capacity for absorbing gases and moisture, and rises, carrying such odors as it may have collected along with it. Thus, cold air, though it be not wholly pure, does not contaminate milk, but tends to purify it. Milk will not become contaminated, even in the stable, so long as it is warmer than the surrounding air. The question how stable-odors get into milk is answered by the statement that they are acquired from the breath of the cow. The animal can not avoid taking in these odors, and upon entering the lungs they are forced at once into the circulation. The blood becomes charged with them, and the milk, which serves as a means of unloading the blood of its impurities as well as of its nutriment, also becomes loaded with them intensified.

Individual Enterprise in Scientific Research.—While different governments have equipped large expeditions and spent considerable sums of money to assist deep-sea dredging expeditions, a similar work has been going on in Switzerland, which has no marine and not a very plethoric treasury, by individual effort, in the study of life in the depths of the lakes. The brunt of the labor has been performed by Dr. F. A. Forel, of Morgues, Professor of Comparative Anatomy in the Academy of Lausanne, who is at home in nearly all the sciences, a man in the vigor of his age, very active and very enterprising, and acquainted with Lake Leman to its very bottom and in all its moods. He has published a considerable number of memoirs respecting his explorations, and the lessons in biology and the theory of development which they suggest, of which he takes the broadest views, and to which he has given thorough examination. His principal collaborator in the zoölogical field is Dr. Du Plessis, Professor of Zoölogy in the Academy, who has been for twelve years engaged in the determination of genera and species, and has prepared a critical table of the species constituting the deep-zone fauna. Dr. Forel has personally made soundings and examinations, besides Lake Leman, in the Lakes of Annecy, Morat, Neufchâtel, Zürich, and Constance. Professor Pavesi, of the University of Pavia, has explored the lakes of the canton of Tessin and Northern Italy. Dr. Asper, of the University of Zürich, has dredged in the lakes of Zurich, Wallenstadt, Egeri, Zug, the Lake of the Four Cantons, Lugano, Como, Klönthal, Silse, and Silvaplana. Some of these lakes are situated high upon the Alps, and are consequently of interest in the study of the vertical distribution of species. Dr. Imhof, of Zürich, has also examined several lakes, and contemplates extending his studies over a considerable geographical area. August Weissman, of Fribourg-in-

Brisgau, has also published some works on the inhabitants of the Lake of Constance.

Family-Schools of Housekeeping.—A writer in the "Pall Mall Gazette" who has herself been trained in that way proposes, as a means of putting an end to the troubles about poor servants and bad housekeeping, that the German plan be adopted of sending every young girl after she has finished her school education, and before she is "out," to learn housekeeping. This every girl in Germany does, be she the daughter of nobleman, officer, or small official. She goes direct from school into a family corresponding with her station in life. Those who are rich go where they are paid highly, and are in "good family," so that they are enabled to live well and have good cooking and great variety. No one is taken into one of these establishments for less than a year, so that every month a new branch is learned—one month the preserving of fruit in season, the next laying-in of apples and vegetables for winter use, preserving of eggs and butter, etc. These girls are taught everything, from washing up dishes, sweeping and polishing the floors, clear-starching and ironing, dusting and cleaning ornaments, cooking, laying the table, waiting, polishing the silver and glass up, to decorating the table with flowers and fruit. Great is the ambition of the pupil to hear that her taste and management are the best. Combined with these duties are those of keeping the household linen in repair and learning plain sewing. Thus the young girl gets experience in household affairs. Though the pupils have to learn everything, servants are kept in these establishments, and in their turn are taught by the advanced pupils, who have learned from the mother of the family. This accounts for the excellent housekeeping in Germany, where comfort is combined with economy and the pleasure of having everything precise and clean. The labors of the day are over at midday, that being the dinner-time, when everybody is at liberty for study, needlework, or amusement till time for preparing for supper. There are many families in England who can not afford to keep servants enough to do well all that has to be done. In these families they have to train servants, not being able to afford to keep trained ones. Why not, in these cases, train young ladies (who would also be companions to the daughters)? They might pay something for the instruction, and so put something into the teachers' pocket, while they would also work for her, and at the same time reap information, which they could again impart, and so train good servants, who are at present so hard to get. Mistresses are unable to teach, never having been taught themselves. Thus they are dependent on servants; for when they find fault they are unable, either in cooking or other matters, to point out the mistake or show the correct way. Servants, knowing this fact, are independent and rule the house, and the "mistresses" must submit. The German system of living with a family and learning by experience how to manage a house is far better than either cooking-schools or lectures on the subject, as a greater variety of things are learned, and they are done in a more refined and economical way.

"Rages" in Surgery.—A part of the Presidential address of M. Verneuil at the recent meeting of the French Association consisted in a spirited and somewhat sarcastic protest against the prevalence of fashions, or "rages," as they are colloquially termed, in surgery. When he began his career, tenotomy was the rage, and tendons, ligaments, and muscles were divided subcutaneously in all parts of the body. A little later "resecomania" flourished, especially in Germany and England, so that some surgeons reckoned their resections by the hundred. Nowadays, when a specialist introduces an operation all specialists follow suit, but with a variation in the shape of the new instrument, so that, "if a museum of operative medicine were founded, immense cases would be necessary to exhibit all the lithotomes, urethrotomes, hysterotomes, and other 'tomes,' comprising small unnamed instruments, intended, I believe, to divide strictures of the nasal duct—strictures which, be it said without bitterness, hardly ever exist, or are in places where they have no need of being divided when they do exist." Gynæcology and ophthalmology compete for honors in this department, and the palm must be given to the former, for, apart from cauterizations, etc., of the cervix, it has giv-

en rise to an Emmet's operation, Battey's or Hegar's operation, an Alexander's operation, etc. The reviews and journals speak of them and praise them, so that a gynecologist who has no "cases" to produce is little thought of. In the same strain M. Verneuil criticised other measures recently in vogue, and hinted that most of them would in process of time become as disregarded as the once prevailing fashion of an iridectomy preliminary to cataract extraction. Much had been made of late years, he said, of extirpations of the larynx, of the pharynx, of the stomach, of the uterus, of the kidneys, etc., and he asked, "How many patients have been cured thereby? How many have derived any benefit whatever from these terrible undertakings? Barely ten per cent. For these I admit that the operation has been of service, but for the ninety others can its abuse be denied? Given a hundred cases of disease," he added, "at a certain period one half are operated upon; twenty years later not more than one fourth are submitted to operation. If the results of the two series are equally successful, I conclude that, of fifty of the operations in the first series, twenty-five at least were superfluous."

Mediæval English Law.—A collection of records of English criminal cases of A. D. 1221 has recently been published, in which may be found numerous illustrations of the condition and peculiarities of the law of the period. In a case where the persons charged with a triple murder had fled and could not be held, it was recorded that "Englishry was not proved, therefore there are three fines." This refers to a rule made by the Conqueror, for the protection of his followers, that the hundred or township in which a foreigner was slain should be fined if the slayer was not produced. On the strength of this, the lawyers invented a tradition that every one should be considered a foreigner till it could be proved that he was an Englishman; and they took care that this should not be an easy thing to prove. In Gloucestershire, where these trials took place, three witnesses had to be produced, two on the father's and one on the mother's side. No woman's testimony was admitted. Consequently, in a great many cases, where probably there was no reason to believe the victim to have been a foreigner, "Englishry was not proved," and the death-fine was exacted. Prisoners not caught in the commission of the offense seem to have had the privilege of declining to be tried, when they enjoyed the possibility of escaping punishment. One John de la Mare, who had killed a miller with a stone, refused to be tried by a jury, saying he had been in the war with King John, and had done harm to many people. He was not produced when he was wanted, and his securities were fined half a mark apiece. A father and son, suspected of murdering a person who had been their guest, denied the charge, and refused to put themselves on their country. The jury, corresponding to our grand jury, however, declared that the son and his mother had committed the murder, and decided that the father should be released on bail, while the others should be kept in prison. The records of the trials offer several instances of the old custom of levying deodands. Robert Sprenghose fell from his horse and was drowned. The value of the horse, two marks, was assessed as deodand. One Osbert fell from his horse and was drowned in the Severn; the horse had no value, and no deodand could be assessed. "William Miel fell down dead as he drove the plough of Richard Sarg, his master, and Richard Witepirie, who was with him and held the plough, fled in a fright; but he is not suspected by twelve jurors, who declare on their oath that this happened by maladventure, and that the man had the falling-sickness." The justices decreed: "If Richard returns, he is to be left in peace. The coroner has forty pence of the said Richard's chattels. These are a deodand, and are to go to the house of Llantony." The power of levying deodands gave opportunities for abuse, which, with other opportunities of a similar tendency, the sheriffs were not slow of improving to their own profit.

Salt Lakes of the Murghab Valley.—In the Murghab Valley, Afghanistan, are two lakes of solid salt, which Captain Yate has ridden over and described. One, from which the Tekke-Turkomans of Merv get their supplies of salt, is in a valley about

six miles square, which is surrounded by a steep, almost precipitous descent, impassable for baggage-animals except by a single road. The bed of the lake, which is about fourteen hundred and thirty feet above the sea, is one solid mass of hard salt, perfectly level, and covered by only an inch or two of water. To ride over it was like riding over ice or cement. The bottom was covered with a slight sediment, but, when that was scraped away, the pure white salt shone out below. No one has ever got to the bottom of the deposit. The second lake is the one from which the Saryks of Penjdeh take their salt, and is about eight hundred feet above the sea. The salt in this lake is not so smooth as in the other one, and does not look so pure. It is dug out in flakes or strata, generally of some four inches in thickness, and is loaded into bags and carried off for sale without further preparation.

Production of Beet-Sugar in Germany.—The consular reports to our Department of State show that the beet-sugar industry in Germany has made great progress during the last twelve years. The exportation of this sugar only began in 1860, but it has been fostered by the Government through the grant of drawbacks that really amounted to bounties till it has undergone a remarkable development. In Pomerania, while in 1871–'72, 38,000 tons of beets were manufactured into 3,000 tons of sugar, in 1882–'83, 7,700 tons of sugar were obtained from 84,000 tons of beets. It is estimated that there are now 525,000 acres of land under beet-cultivation in Germany; and it appears that there were, during the year 1882–'83, 358 factories in operation, as compared with 343 in the previous year, and that they produced 835,164 tons of raw sugar, against 599,722 tons in 1881'–82. The taxes paid by the industry amounted to $35,000,000 as compared with $25,085,000. It is expected that for 1883–'84 there will be found an increase of at least fifteen new factories over those in operation in 1882–'83. As compared with the year 1871–'72, in that year 2,251,000 tons of beets were used to produce 186,442 tons of sugar, while in 1882–'83, 8,747,000 tons of beets were used, producing 835,164 tons of sugar. The quantity of beet-root used to produce a pound of sugar has diminished, under increased skill in the manufacture, from about twelve pounds to a fraction over ten pounds.

The Harmony of Colors.—M. Chevreul, the chemist, although in his hundredth year, is not too old to discuss the interesting question of bonnets and millinery. A black bonnet, he says, with white, pink, or red feathers or flowers, suits a fair complexion. A dead white hat is only suitable for florid complexions, whether blondes or brunettes. Gauze crape or tulle bonnets suit all complexions. A white bonnet for a blonde should have white or pink flowers; blue is still better. Brunettes should avoid blue, and rather choose red, pink, or orange. Light blue bonnets are especially suitable for fair persons. They may be trimmed with white flowers, or even yellow or orange, but not pink or violet. For dark persons who venture to wear a blue bonnet, yellow or orange is indispensable. A green bonnet sets off a pale or slightly colored complexion. A pink bonnet should not be too near the face, but should be separated by the hair, or by a white or green inside trimming, the latter color especially. White flowers, with an abundance of leaves, produce a good effect on pink. A dark-red bonnet is only suitable for persons with a highly colored complexion. Avoid yellow or orange bonnets. Violet is not to be recommended unless separated from the face, not only by the hair but by yellow accessories also.

Estimating the Age of Trees.—Mr. John T. Campbell, of Rockville, Indiana, records in the "American Naturalist" some of the results of his observations on the age of forest-trees as determined by their rings of growth. He regards the rings as capable, when correctly interpreted, of giving the true history of the tree, and showing the dates of prosperity and adversity in its career. The amount of growth between the rings is not determined by the character of the particular season in which each year's growth is made, as is generally believed, but by other conditions, such as the provision of top and branches and the presence or absence of rival trees competing with it for air, light, and moisture. He found stumps

of trees of the same species, the same size, and presumably the same age, standing within twenty feet of each other, on the same kind of soil, cut down the same year, and, so far as he could judge, subject to the same conditions throughout, "one showing a large ring where its neighbor would show only an average one, and in some few cases they showed the opposite." While he can not account for the spasmodic production of single rings of large or small growth, interspersed here and there among those of average size, he has been able to trace successions of large or small rings to some plausible cause. In making some surveys, he had had occasion to refer to two trees which had been marked in the Government surveys of fifty years before, as "witness-trees," to aid in identifying corners. Both were described in the field-notes of those surveys as ash-trees three inches in diameter. One had grown to be eighteen inches in diameter; while the other had added only a half inch to that dimension, but the required rings of growth could be plainly seen under the glass. The former tree had had a good soil on level ground, while all of its adult rivals had been blown down by a tornado which had passed over the spot. The latter tree "stood in dissolved sandstone for soil, on the top of a narrow ridge, between three large oaks, which robbed it of sunlight and rain, and nearly all the soil nourishment. It had but five or six small branches for a top, and but few leaves to a branch; under such conditions it did well even to exist." Mr. Campbell read the history of two oaks as it was revealed to him by the rings and the configuration of the ground. One sprouted from the seed in 1502; the other, twenty feet distant from it, in 1594, or ninety-two years afterward. "In 1731 a tornado from the northwest blew down a still older oak, which in its fall struck against and greatly damaged the top of the one born in 1502." The two younger trees had been freshly cut down when the author examined them. "Their stumps were about four feet across, and there was not over an inch difference between their diameters, though ninety-two years difference in their ages. The younger had a large, healthy top, no broken or dead limbs, and it had put on rings of growth from the beginning of more than average size. The older one had been injured in its branches by the fall of the still older tree before mentioned (in 1731), and for fifty-seven years had put on very small rings of growth, . . . when a new set of branches developed to take the place of the damaged ones, and the rings began to increase in size and gradually attained to the average. I examined their tops, which coincided with what has gone before. There were the peculiar knots in the top of the older one where dead limbs had rotted off and were healed over. During this delay the younger oak caught up with the older one in size. The size of a tree is a very uncertain indication of its age." Mr. Campbell examined one tree that was six hundred years old, and learned from it that "at the age of about two hundred years it had some ill fortune which caused it to form about one hundred small rings. It then regained its health and formed normal rings for about one hundred and forty years, when another mishap caused small rings till within the last fifty years, when it was putting on fair growths again."

Uses and Nature of Physiological Experiment.—Dr. H. Newell-Martin has replied to an accusation made against him in the London "Zoöphilist," of practicing cruelty in his physiological experiments on living animals. First, he responds to the charge that the experiments are useless, saying: "Every one is aware that in very many cases severe fevers result in death. It is well known to most medical men that most such deaths are due to failure of the heart. This failure is caused by too rapid beat, the organ not getting rest enough between its strokes for nourishment and repair. This quicker beat might be due to any of four or five possible causes. . . . To ascertain which of them was mainly responsible for it, and thus throw light upon the proper means to be adopted to save life, was the object of my research; an object which, I am proud to say, I in large measure attained." In regard to the amount of pain inflicted in the experiments, his first endeavor was "to put out of action, *to kill*, all parts of the body but the heart and lungs. These do not possess consciousness, and are incapable of suf-

fering pain when the brain is dead." In doing this "no pain whatever was inflicted, except, in some, the slight smarting due to hypodermic injection of morphine. Two experiments were performed under curare, a drug the power of which to destroy consciousness is still in doubt. . . . The reason for making these was that chloroform, ether, and morphine, act themselves on the heart; and, finally, to clinch the question as to the influence of hot blood on that organ, it was necessary to experiment on a heart which had not been exposed to possible alteration by the action of any one of them. In these cases pain was stopped as soon as possible by tying the carotids, and this took three or four minutes. . . . If," Professor Martin adds, "the precise truth concerning every physiological experiment made in this country be brought before the public immediately after its misrepresentation in any anti-vivisection journal, our science is safe. Truth can not hurt it. Publicity will swell the ranks of its students. Legislation impeding our work need not be feared. Human and animal disease and suffering will be diminished, life prolonged, and the world made better as well as happier, through our researches. If we fail to use every effort to protect and promote those researches, are we not guilty toward our fellow-men and the lower animals dependent on us?"

Who shall try the Dynamiters?—In an article on "Dynamiting and Extra-Territorial Crime," Mr. Francis Wharton, LL. D., has aimed to show that the prosecution of persons sending dynamite abroad for criminal purposes belongs to the states from whose soil the dynamite is sent. Authorities on the law of nations agree in maintaining that when, in one sovereignty, overt acts are taken toward the commission of a crime in a foreign land, jurisdiction exists both in the place of preparation and in the place of execution. A similar doctrine has been repeatedly held in England, as growing out of the common law; and British courts have enforced the obligation to punish persons, whether British subjects or foreigners sojourning in the country, who prepare in the United Kingdom attacks to be made in other countries. The same principle has been observed in the United States. The particular question Mr. Wharton discusses is, whether, in such crimes as dynamiting, the jurisdiction should lie in the Federal courts or in those of individual States. The foreign country sees only the nation; but, within the nation, what entity should answer the responsibility? The General Government has already taken cognizance of offenses of this class where sovereigns are concerned, as it might well do, by virtue of its functions in maintaining diplomatic intercourse with their courts. But to hold the same attitude with respect to common crimes against common persons, or the general public, would be to trespass upon the duties and prerogatives of the States. It would, moreover, tend to give those offenses and the measures taken against them a political aspect, and to call in all the complications of political feelings and prejudices. The question should be made to appear as a matter of social order, affecting the homes and lives of the whole community from which the jury to decide upon it is drawn. To make it a matter of national concern would at once divide the jury according to their national sympathies. "It would be otherwise, however, when the question is, whether the law permits dynamiting, or whether it will stop dynamiting at the place where it is started, which is the only place where it can be stopped."

Hindoo Cosmogony and Physics.—The Rev. Sumangala, chief-priest at Adam's Peak, in Ceylon, has recently published an account of the opinions of Hindoo astronomers on the form and attraction of the earth. Bhaskara, who flourished in the twelfth century, thought that the terrestrial globe, composed of land, air, water, space, and fire, had a spherical form, and, surrounded by the planets and the orbits of the stars, maintained itself in space by its own power. This, he says, is in fact demonstrated. Lands, mountains, gardens, and houses cover the earth as pollen covers the flower of Kadamba, and serve as the homes of men, Raksasas, Devas, and Asuras. He rejected the idea that the earth rested on anything else, for the obvious reason that, if another support were needed, there would be no end to the supplementary supports. Therefore we shall have to admit a final

equilibrium somewhere; why not accept it at once? "Is not the earth one of the forms of Siva? As heat occurs naturally in the sun and fire, cold in the moon, fluidity in water, and hardness in the stone, so mobility exists in the air. Every object has its own properties, and the properties implanted in some objects are wonderful." Bhaskara believed that the earth, possessing an attractive force, drew to itself everything heavy in the atmosphere surrounding it, whence those bodies fall to it. "But," he said, "how could the earth fall into the ethereal space, since that space is equal on all sides?"

Opposing Views of Arctic Exploration.—Admiral Bedford Pim, in a recent lecture on "Arctic Exploration," related a conversation he had had with Secretary of War Lincoln, on the utility of the perilous adventures undertaken for that purpose. The Secretary asked him, "What is the good of the journeys to those regions, and how can you defend the fearful loss of life, unnecessarily, as I think, thrown away?" The admiral, in reply, recalled the biblical command to replenish the earth and subdue it, and asked: "How can we possibly do that if we are not even acquainted with its land and water? And then, with respect to the loss of life, more men have been slaughtered in one skirmish than have been lost in the polar expeditions for four hundred years; in point of fact, the percentage of loss of life in the polar regions is less than in any other sea employment. Then, some of the best examples of seamen, both morally and physically, have been men trained in all the hardships and dangers and difficulties of the polar regions. I can conceive of no better school. . . . The spirit of enterprise is strongly encouraged by these expeditions. And, depend upon it, if we men are such arrant cowards, and so forgetful of our duty, as to abandon research until somebody's flag is planted on the north pole, the ladies will do it." Lieutenant Danenhower opposes further attempts to penetrate the polar area for the present. While nothing useful is to be attained there in the way of geographical discovery, it is well to weigh the comparative importance of investigation in that branch in other parts of the world. British America has not been fully explored, though it possesses an area more than eight times that of the central polar region. Much work needs to be done in Central Africa, the Himalayas, New Guinea, and other parts of the world. For hydrographic research, it is not necessary to go to these regions, but the best field for operations lies below the eightieth parallel. As for the interests of meteorology, "there is no special reason for believing that the meteorological phenomena of the central polar regions differ essentially from those observed near the borders, and the possible advantages to be gained would not alone justify further exploration." Neither is any great advantage to be gained for magnetic and auroral observations. The magnetic poles are known, and are in or near already explored regions, and the most brilliant auroral phenomena are observed near them. In short, we know nearly as much on all these subjects, or can study them as well in the regions we have already opened, as we could learn by going to the pole. But "the time may come in the progress of civilization and advanced knowledge when the exploration of all the present unknown parts of the torrid and temperate zones shall have been completed, and it will then be the occasion to explore the ice-locked regions of the north pole"; and, "after having served with one Arctic expedition, and having devoted seven years to the study of the subject, . . . I unhesitatingly record myself as opposed to further exploration of the central polar basin, with our present resources. The gradual extension of observatory stations in the interest of meteorology, magnetism, and other scientific branches, should be made, but national support should not be given to another polar expedition."

Meteorology of the Congo.—Mr. A. von Danckelmann, a German meteorologist, has been making observations at Vivi, in the country of the Congo, and reports some curious results. During about a year that he stayed there the barometrical column did not vary more than ten millimetres; even the passage of tornadoes seemed to produce no greater effect upon it. The year is divided into rainy and dry seasons. During

the latter, from May to October, no rain falls, but the earth is occasionally moistened by the depositions from fogs. From November to April heavy showers of short duration prevail, and the water falls, in portions, sometimes as high as one hundred and two millimetres — about four inches — in two hours. Long, fine rains are unknown. The country is visited by cyclones, but, while storms passing to the north of the station turned the vane in a contrary direction to that of the hands of a watch, those passing it to the south turned it in a direction corresponding with theirs. The natives burn the tall prairie-grass in the dry seasons, causing fires that last for a long time, and produce considerable meteorological effects. The air is constantly loaded with smoke, while cumulus clouds are formed over the fires and emit lightning with thunder. One of the most remarkable meteorological phenomena of the region is the existence of a southwest wind, which, beginning at sunset, blows all night till sunrise with such force as to raise large and dangerous waves on the river.

An Affectionate Mother-Spider. — The *Clubiories* are minute, grayish-yellow spiders with a dark-brown stripe along their back, which build their nests among growing oats, generally using two or three stalks. M. Ernest Menault, a French naturalist, looked into one of their nests and found there a great number of little eggs in various stages of development. The mother-spider was frightened and much excited on observing his proceedings, and endeavored vainly to collect her treasures again. From another nest M. Menault tore away the protecting web, but the diligent mother soon set herself to work spinning a patch to cover exactly the breach he had made. He repeated the experiment several times, and the spider as often came to repair the mischief. Another spider, the *lycosa*, gathers her eggs, as soon as they are laid, into a little ball, which she then wraps with a thin but compact and solid covering of silky tissue. This ball, stuck to her web, she drags after her wherever she goes. When pursued, she runs as quickly as the weight of the egg-ball will let her, but, if any attempt be made to seize the cocoon, she stops at once and tries to get it back, when she shows considerable courage and fighting capacity. If the cocoon is destroyed, the *lycosa* will retire into a corner, and in a short time die. When the eggs are hatched the mother-spider takes her young upon her back, and has them always with her. "It is impossible," says M. Menault, "to behold without emotion this little creature, naturally so quick and jerky in all her movements, acquire a motion so much gentler when carrying her treasures. She carefully avoids all dangers, only attacks easily won prey, and abandons all chance of obtaining anything the capture of which would necessitate a combat that might cause her to drop the young ones, which press and move by hundreds round her body." Bonnet tells of a *lycosa* whose egg-bag was captured by an ant-lion, which nevertheless refused to leave it, preferring to be swallowed up and share the fate of her eggs. When taken away by force, she persisted in returning to the scene of danger.

Race Characteristics of the Jews.—Dr. A. Neubauer read a paper recently, before the British Anthropological Institute, on "Race Types of the Jews," the purport of which was to show that there had been considerable intermixtures in the Hebrew race from the time of Abraham down. Joseph married an Egyptian and Moses a Midianite; David was descended from a Moabitess, and Solomon was the son of a Hittite woman. So we read of the non-Jewish women in contact with the Israelites, and undoubtedly the proselytes increased the mixture of races by marrying Jewish women. Moreover, some quite marked differences prevailed in the middle ages, and still exist, between the Jews residing in different nations. Mr. J. Jacobs, in a paper "On the Racial Characteristics of Modern Jews," took a different view. Regarding only the Askenasian Jews, who form more than nine tenths of the whole number, he pointed out as among their characteristics fertility, short stature as compared with Europeans, and narrow chests, brachycephalic skulls, darker hair and eyes than those of any nation in Northern Europe (though nearly one fifth of the Jews have blue eyes, and they have nearly twice as many red-haired individuals as the inhabitants of the Continent), and a peculiar

cast of countenance. He pointed out that the purity of the race depended on the number of proselytes made by the Jews in ancient and mediæval times. The earlier proselytes, before the foundation of Christianity, were mostly fellow-Semites, and would not affect the type, while the numbers made afterward were too small to modify the race. A considerable number of Jews, the Cohens, were not allowed to marry proselytes, and must consequently be tolerably pure. Mr. Jacobs's general conclusion was therefore in favor of the purity of the Jewish race.

The Elm-Leaf Beetle.—The entomological division of the Department of Agriculture has published an account, prepared by Dr. Riley, of the elm-leaf beetle (*Galeruca xanthomelana*), which has committed serious damage upon the elms in many States during the past few years. It is an importation from abroad, and fortunately gives its attention mostly to foreign species of elm, the common native species, *Ulmus Americana*, being generally exempt from its ravages. The injuries it commits are severe about one year in three, while they are relatively light in the intervening years. It works its destruction from May to August, and prefers the warm side of the tree. The most effective remedies against it are the ordinary arsenic washes and powders, and these appear to injure the tree as well as kill the insect. Their effect is also worst on those species and varieties which suffer most from the ravages of the beetle. In administering the poison, it is well to anticipate the appearance of the insect, so as to prevent its getting a start.

Conditions of Success in Life.—The physiological conditions of success in life, according to Dr. James T. Searcy, of Tuscaloosa, Alabama, in his address before the State Medical Association, consist chiefly in the vigorous and healthy action of the brain and nervous system. Therefore the structural integrity and functional capacity of the brain are most important matters, and how to preserve and improve them are vital questions. Hence the author believes, "if we can discover the ways in which brain capacity is improved, we will have done a great deal, and, if we can state the ways in which it is lowered, we will have done a great deal." The excellent man will not only show his ability to take in, to understand, but he will also show it in knowing what to take in, in his ability to select for a purpose. "The successful man possesses ability not only to learn, but to verify his learning and to use his conclusions correctly, and execute them tenaciously. The simply erudite man is not the successful one. He must be capable not only in his receptive ability, but also in his adjusting and emissive abilities. This often puts the man who is simply the scholar at such disadvantage in the presence even of the unlettered man of 'common sense.' 'Common sense' may be defined to be the inherent excellence of capacity in all three of the departments of brain-action. He need not be an 'educated' man to show this trait, but if he is educated his inherent 'common sense' tells all the better. He learns well and properly, he reasons well and properly, and he executes well and properly."

How Woods preserve Moisture.—M. Woeikoff, an eminent Russian observer, asserts, in a recent article in Petermann's "Mittheilungen," that the office of forests in diminishing evaporation can not be explained by the lower temperature or the greater humidity which are known to exist under their shadow. The most important factor contributing to the result is the resistance opposed by woods to the winds, the force of which being greatly reduced under the trees, the air is changed more slowly, and consequently the moisture is less readily carried away. Documents which have been collected at Nancy, in France, show that the vicinity of a forest increases the quantity of rain. It would seem that in Central Europe, where the difference between the temperature of the ground and air within the forest and that of the open is but little in the winter, the forests would have slight influence on precipitation at that season. Nevertheless, the forests receive more water than the open spaces in winter, because of the lowness of the clouds combined with the resistance that the woods offer to the moist west winds. Rain-water is stored in the moss and herbage of the woods, to be con-

sumed by the vegetation during the dry season. A striking illustration of this fact is given in a forest on the western coast of the Caspian Sea, where the vegetation is very luxuriant, although it never rains except in the fall and winter. M. Woeikoff has also observed that forests depress the temperature of the neighboring regions. Thus the normal temperature ordinarily increases as we go from the sea toward the interior in Western Europe and Asia; but the presence of a forest compensates for the rise in temperature, so that there are places far from the sea that are cooler than the shore itself. This is the case in Bosnia, where the summer is five or six degrees cooler than in Herzegovina, on account of the woods.

NOTES.

According to "Wood and Iron," of the four hundred and thirteen species of trees found in the United States, the perfectly dry wood of sixteen species will sink in water. The heaviest of these is the black iron-wood of Southern Florida, which is thirty per cent heavier than water. Others of the best-known species are the lignum-vitæ, mangrove, and a small oak found at elevations of from five to ten thousand feet in Western Texas, Southern New Mexico, and Arizona. All the species are natives of Florida or of the dry interior Pacific region.

Artesian wells have been in operation in the Sahara from a very remote period, and new ones have been opened by the French in the Algerian portion of the desert with considerable success. At the same time a large increase has taken place in the number of palm and other fruit trees. The limit of the capacity of the veins to be found at the usual depth of one hundred metres appears, however, to have been reached at last, for the borings made since 1881 show a diminished yield of water. The French wells, moreover, are harder to clean when they are stopped up by sand than the Arabian ones, on account of their smaller bore; and it is believed that new wells will have to be made, of larger caliber.

M. Bocion, of the Cantonal Industrial School of Lausanne, Switzerland, reports the discovery in Lake Leman of a bright-green moss growing in the bottom of the lake, on the calcareous rocks, two hundred feet below the surface. No other moss has been found at so great a depth under water; and how chlorophyl could have been so richly developed so far from the light is a problem.

Professor Purdie, having analyzed a specimen of the milk of the porpoise, gives the following as its composition per hundred parts: Water, 41·11; fat, 45·80; albuminoids, 11·19; milk-sugar, 1·33; mineral salts, 0·57. The substance set down as milk-sugar was too small in quantity for accurate examination, and is regarded by the analyst as very probably some albuminoid matter. The most remarkable point about the composition of the milk is the large percentage of fat which it contains, a constituent of food of which the cetaceans would naturally require a larger proportion than ordinary mammals do. The milk was yellow and thick, and had a fishy smell; and its specific gravity differed but little from that of water.

Mr. E. T. Newton has described the remains of a gigantic bird—the *Gastornis Klaasensii*—found in the Lower Eocene of Croydon, England, which indicates a species as large as the Dinornis of New Zealand. The most perfect tibiotarsus, when complete, must have had a length of at least twenty inches, and its trochlea is three and a half inches wide, while in another specimen the trochlea is four inches wide. The anserine affinities of Gastornis, as regards the tibiotarsus, are confirmed by the detailed comparison of the Croydon bones with recent forms.

According to M. Dinnik, a Russian traveler in the Caucasus, it is the custom among the Ossetes (one of the peoples of the country) for the lucky sportsman or treasure-finder to deposit some part of his spoil in the sanctuary of Rekom, in the Zéa Valley, and that temple has become a kind of curiosity-shop. The outside of the building is decorated with horns, from the examination of which M. Dinnik has been able to solve a question respecting the geographical range of two species of goats. The funeral mounds of Ossetia also furnish offerings to Rekom, which are brought to it by persons who dig in them for the gold ornaments they may find deposited there. Armlets, rings, knives, and lance-heads of the bronze period are among the curiosities of this strange mountain museum; but other uses than that of consecration appear to be found for articles of gold.

Tests made with small squares of different kinds of wood, buried an inch in the ground, have shown, according to the "Garden," that birch and aspen decayed in three years; willow and horse-chestnut in four years; maple and red beech in five years; elm, ash, hornbeam, and Lombardy poplar in seven years; and oak, Scotch fir, Weymouth pine, and silver fir, to a depth of half an inch, in seven years; while larch, juniper, and arbor-vitæ were uninjured at the expiration of the seven years.

M. GUSTAV LE BON believes that a good place to look for the origin of cholera may be in the volatile ptomaines, or alkaloids of putrefaction emitted by organic substances in the later stages of decay. The ptomaines developed in the earlier stages of putrefaction appear according to his researches to be usually solid or liquid, and much less dangerous than those which escape at a later stage, and which, being volatile, have thus far eluded examination. But these last, when taken into the system by the breath, produce deadly effects. M. Le Bon's conclusions on this subject have been derived from observation of the progress of cholera at Kombakonum, in Southern India.

J. GRABER has made experiments with animals of the classes of vertebrates, articulates, mollusks, and worms, from which he has determined that the sense of color and the power of perceiving light are more widely distributed than has generally been supposed. The variations in the sense of color among animals are very great.

SULITJELMA, on the Norwegian frontier, in latitude 67½°, 6,000 feet high, and Sarjektjåkko, in Swedish Lapland, 1,000 feet higher, have in turn been put forward as the highest mountain in Sweden. They both have now to give place, on the testimony of Dr. Svenonius, to Kebneksisse, in Lapland, which is 7,300 feet above the level of the sea.

PROFESSOR W. MATTIEU WILLIAMS indicates as probable sources of nitrogen in soils, and serving as food for plants, the dead bodies of insects, excreta of living insects, invisible spores, microbes, and particles of organic fluff which are always floating in the air and liable to adhere to the moistened surface of the soil and of the leaves of the growing plants. To prove the existence of such deposits on leaves, moisten a white pocket-handkerchief and gently rub it over the surface of the leaf of any growing plant in dry weather. No matter how far from the smoke of towns, the soiling of the handkerchief will show a deposit of solid matter, of which a considerable proportion is organic.

EXAMINATION in the color-blind test is now obligatory on candidates for masters' and mates' certificates in the British mercantile marine. Failure to pass the test does not now prevent the candidate receiving his certificate, as it did when the examinations were first instituted, but the certificate is given with the indorsement, "The holder has failed to pass the examination in colors." This examination is not yet made obligatory on pilots and men on the "lookout," and this ought to be regarded as a serious omission; for collisions are certainly more apt to occur off the coasts, when the vessels are under the charge of pilots, than out at sea, where they have been given over to the masters and mates.

DR. HERTEL, of Copenhagen, has published the results of a sanitary inspection of the schools of that city, from which it appears that about one third of the pupils are sickly. With respect to the girls, the fact is brought out that "between the ages of twelve and sixteen the number of sickly girls increases till it exceeds that of healthy by ten per cent, except at the age of fourteen, when the figures are equal." Dr. Hertel also made inquiries into the condition of some German schools, and brought out the fact that in a single group of them three fourths of the pupils of the highest class have defective eye-sight.

THE Japanese have promulgated a patent law, which seems to be a compilation of various provisions selected from the laws of other countries. The term of protection is fifteen years. Articles "that tend to disturb social tranquillity, or demoralize customs and fashions, or are injurious to health," and medicines, are excepted from its benefits. Among the conditions on which patents are granted, it is prescribed that the articles must have been publicly applied within two years, and that the patents shall become void when the patented inventions have been imported from abroad and sold.

M. E. SENET claims to have employed a process for electroplating with aluminum, by which the deposition of that metal is effected as easily as is that of copper or silver. He uses a saturated solution of sulphate of aluminum and a solution of chloride of sodium, keeping them separated by a porous vessel. Under the action of the galvanic current a double chloride of aluminum and sodium is formed, which decomposes at once, the aluminum being set free and depositing itself at the negative electrode upon whatever object may be placed there to receive it.

MR. J. D. HYATT, in his studies of compound eyes and multiple images, remarks as a curious peculiarity of the eyes of the horse-fly that the lenses of the upper and anterior part are much larger than those situated below a median line, the larger facets having at least twice the diameter, or four times the superficial area, of the smaller. The larger lenses form pictures at a plane considerably above the focal plane of the smaller ones. Thus these insects are furnished with eyes of two varieties, corresponding to our long-sight and short-sight spectacles; in other words, with telescopic and microscopical eyes, the telescopic looking upward and forward and the microscopical downward.

PROFESSOR D. P. PENHALLOW, having studied the relation of annual rings to the age of trees, concludes that the formation of rings of growth is chiefly determined by whatever operates to produce alternating periods of physiological rest and activity. In cold climates the rings are an approximately correct, but not always certain, index of age; but in warm climates they are of little or no value in this respect. The influence of meteorological conditions in determining the growth of each season is most important, particularly with reference to rainfall. Periodicity in rainfall corresponds with periodicity in growth.

SOME of the German journals describe a plant which has lately been discovered to have electrical properties. It is called the *Phytolacca electrica*. It gives a slight electric shock to the hand when its stalk is broken, and affects the magnetic needle, disturbing it considerably if brought very near. Its energy varies during the day, being strongest at about two o'clock in the afternoon and falling away to nothing at night.

M. A. DE ABBADIE states that the mercurial bath at his observatory in France, about a mile and a half from the Spanish frontier, was subjected to extraordinary and almost continuous agitations during all of last winter, beginning with the 1st of December. The oscillations sometimes reached 30″ and were on one day, the 23d of December, as frequent as four in a second. He believes there was a connection between the oscillations, or the cause of them, and the earthquakes in Spain.

A LECTURE on fish-culture, delivered recently in Hull, England, by Mr. W. Oldham Chambers, was illustrated by object-lessons of living specimens of the white-fish and other foreign species.

OBITUARY NOTES.

JAMES MACFARLANE, of Towanda, Pennsylvania, author of a valuable work on the coal-fields of America, and of the "Geologists' Traveling Hand-book," died suddenly on the 11th of October. He was engaged at the time of his death in the revision for a new edition of the "Geologists' Traveling Hand-book," in which are given descriptions of the geological formations along all the railroad routes of the country.

MR. THOMAS BLAND, an eminent conchologist, died in New York on the 20th of August last, in the seventy-seventh year of his age. He was born in England, and inherited a taste for conchology from his mother. He removed to Barbadoes in 1842, and thence to Jamaica. He became superintendent of a gold-mine in New Granada in 1850, whence he removed to New York in 1852. Here he became associated with Mr. W. G. Binney in the study of our land-shells and in the publication of works which have greatly elucidated the subject. The catalogue of his scientific writings contains seventy-two titles.

EDWARD HENRI VON BAUMHAUER, Secretary of the Dutch Scientific Society at Haarlem, and editor of its "Archives," died last year, in the sixty-sixth year of his age.

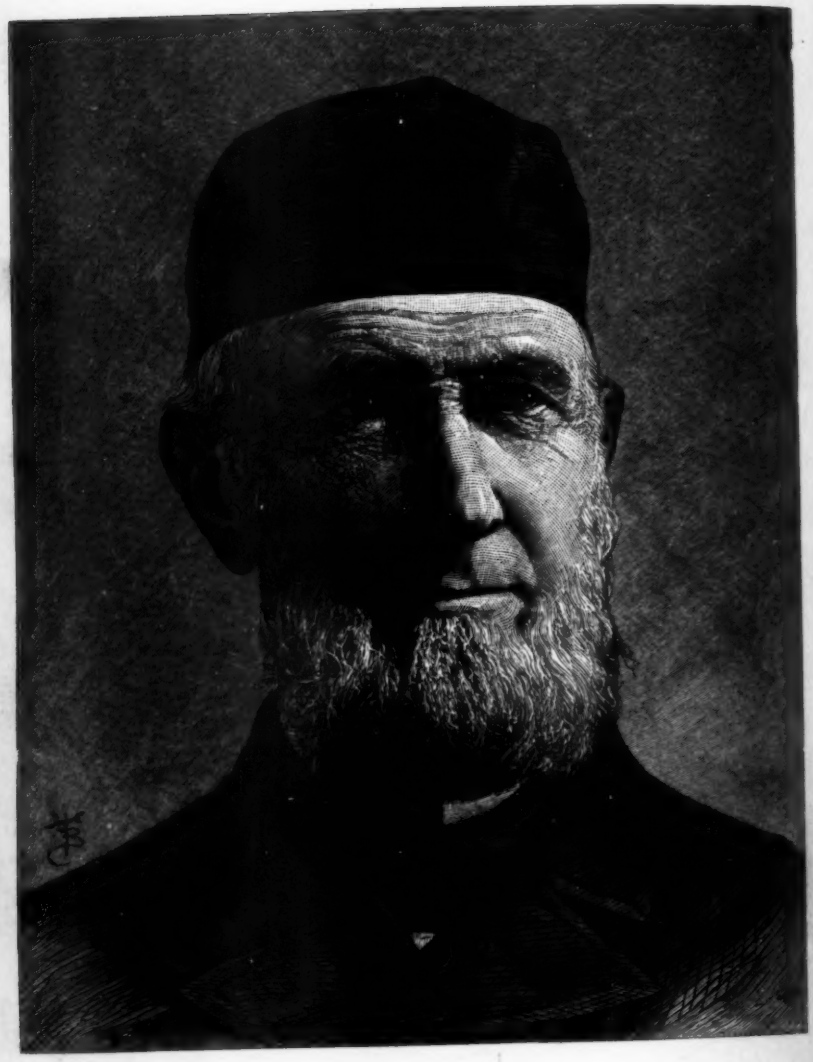
DR. J. J. BAEYER, a distinguished authority in geodesy, founder of the European *Gradmessung*, and president of the Central Bureau of the society, and of the Royal Prussian Geodetic Institute, died September 10th, aged ninety-one years.

W. WOODBURY, the inventor of the Woodbury type process for multiplying photographic pictures, died in Margate, England, September 5th, from the effects of an overdose of laudanum, which he was accustomed to take to allay sleeplessness. He was fifty-one years of age. Notwithstanding the value of his inventions and the great use that has been made of them, it is said that he left his family poor.

DR. NICOLAS JOLY, honorary professor in the Faculty of Sciences and in the Medical School of Toulouse, France, died in that city October 17th, in the seventy-fourth year of his age. He was best known, perhaps, by the controversy which he, with MM. Pouchet and Musset, carried on with M. Pasteur in 1863, on the theory of spontaneous generation, from which M. Pasteur came off with all the honors of victory. He was the author of numerous publications of merit in zoölogy and prehistoric ethnography; and was one of the founders of "La Nature," and a frequent contributor to its pages.

DR. THOMAS DAVIDSON, F. R. S., of Muirhouse, Midlothian, Scotland, the highest authority on British fossil Brachiopoda, died at West Brighton, England, October 16th, in his sixty-ninth year. Up to 1871 he had published forty-nine books and papers, chiefly devoted to his specialty in paleontology. He received medals from the Royal and Geological Societies, and from Sir R. Murchison, and a testimonial from the Paleontographical Society in recognition of his labors.

CHARLES ROBIN, a French physiologist, who introduced the study of histology into his country, died early in October last, in his sixty-fifth year. In announcing his death to the French Academy of Sciences, the president of that body remarked upon the fact that M. Robin had not been able to accept the new facts added by his pupils to the science to which he had given a start, and that he had never been "converted to the doctrines of bacteriology."



JAMES B. EADS.